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JULY 1947
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WITH FOLDED HANDS . . .

BY JACK WILLIAMSON

Reg. U. S. Pat. Off.

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CONTENTS

JULY, 1947 VOL. XXXIX. NO. 5

NOVELETTES

WITH FOLDED HANDS, *by Jack Williamson* . . 6

LOGIC, *by Poul Anderson* 51

SHORT STORY

THE FIGURE, *by Edward Grendon* 46

ARTICLES

OBEY THAT IMPULSE! *by George O. Smith* . . 84

THE STORY OF MODULATION, *by C. Rudmore* 86

SERIAL

FURY, *by Lawrence O'Donnell* 102

Conclusion

READERS' DEPARTMENTS

THE EDITOR'S PAGE 4

IN TIMES TO COME 45

THE ANALYTICAL LABORATORY 76

BRASS TACKS 77

COVER BY TIMMINS

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Editor
JOHN W. CAMPBELL, JR.

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AST—1T

TOO PERFECT PLASTIC

I first heard about teflon from a chemist friend, whose definition of it was simple, direct, and fairly complete. "Well, if I ever discover the universal solvent, I'll know what to keep it in."

Teflon is Du Pont's trade name for a new synthetic plastic. It's straight out of science-fiction, too. It's a horny, whitish material, with—so far—moderately good mechanical properties, chemical properties closely resembling those of helium or argon, electrical properties looking like something an electronics engineer dreamed up in a moment of wishful thinking, and industrial production properties that are currently driving its discoverers quietly mad.

The mechanical properties are moderately good because of the production problem—discussed below.

The electrical properties are magnificent; it makes an insulator of nearly perfect properties—practically no loss even at the enormously high radio frequencies of radar, extremely high resistance, and it is totally uninterested in absorbing moisture. Because it will stand far more heat than any other thermoplastic, it can be used under otherwise adverse conditions.

It's the chemical properties that approach the strictly incredible. It is unaffected by boiling aqua regia, boiling acids—nitric, hydrofluoric, hydrochloric, sulfuric, acetic, or other organic acids—or caustic alkalies. The most violent corrosives known have no effect whatsoever. Elemental fluorine gas doesn't bother it. Sodium peroxide—which rapidly attacks gold, platinum and similar extremely resistant metals—doesn't touch it. Chlorsulfonic acid, which drills through most ordinary materials like a red-hot poker, can do nothing against teflon. The only corrosive reagent they've found yet that will attack it at all is fused metallic sodium at 200°C. And that attacks only slowly. Naturally, since neither ozone, water, nor oxygen can effect it, age and exposure to sunlight has no results.

Teflon is an organic material, so perhaps the organic solvents rather than corrosive agents will be more effective?

The Du Pont chemists have tried

everything standard, and everything else, probable or improbable, they could think of. There's a list of forty-six different solvents—several of the individual items being "Other aromatic hydrocarbons" and "Other halogenated hydrocarbons," and so representing perhaps five to fifty materials each—none of these materials soften it, make it swell, or dissolve it. Starting with water, the list runs through ordinary alcohols, standard cellosolve, benzene and hexachlorethane to the more determined attempts with more esoteric compounds.

Nothing softened it.

Nothing dissolved it.

Bacteria and fungi can't get to first base with it. It's a case of you name it, and teflon's proof against it. And—that's the trouble. Since teflon is unsoftened, unaffected by anything, and like most thermoplastic materials doesn't melt under heat, but simply gets somewhat gooey at high temperatures, there is no way to mold the incredible stuff. It can be extruded at extraordinarily high temperatures (for an organic plastic material—340 to 380°C.) but even at this temperature the viscosity is abnormally high, so that ordinary plastic handling machines must be specially reinforced, as well as being equipped with special heating jackets.

As a varnish or protective coating —because of its inordinate chemical resistance—teflon would be a marvelous thing indeed. *If* something capable of dissolving it into a paintable or sprayable lacquer could be found.

If a plasticizing agent capable of softening it decently could be found, far better moldings and extrusions would be possible. But then—if it were soluble, or could be softened, it wouldn't be the "everything-proof" material it is.

The reason for its fantastic chemical resistance is not hard to understand; teflon is poly-tetrafluoroethylene. Four fluorine atoms tied to two carbon atoms. When fluorine gets hold of something, there is no chemical element that has power enough to pry it loose. Metallic sodium can attract it away from the carbons slowly, but nothing less attractive, less active, than sodium can displace the carbon. Since fluorine can drive oxygen out of its compounds, ozone and oxygen naturally can't bother the tetrafluoro compound. Since it is already a florinated material, elemental fluorine has no effect.

Nor, for that matter, does the violently corrosive uranium hexafluoride that Oak Ridge used. And teflon makes wonderful gaskets for use in pumps and piping handling powerful corrosives. The Manhattan Project had to have something that could stand up to pure elemental fluorine, and to the vast quantities of uranium hexafluoride, both hot gas and cold liquid, under pressure or vacuum, they had to move.

Not all the Manhattan District's work was *atomic* engineering!

THE EDITOR.

WITH FOLDED HANDS . . .

BY JACK WILLIAMSON

Illustrated by Timmins

To serve and obey mankind was good; to protect—was to destroy!

Underhill was walking home from the office, because his wife had the car, the afternoon he first met the new mechanicals. His feet were following his usual diagonal path across a weedy vacant block—his wife usually had the car—and his preoccupied mind was rejecting various impossible ways to meet his notes at the Two Rivers bank, when a new wall stopped him.

The wall wasn't any common brick or stone, but something sleek and bright and strange. Underhill stared up at a long new building. He felt vaguely annoyed and surprised at this glittering obstruction—it certainly hadn't been here last week.

Then he saw the thing in the window.

The window itself wasn't any ordinary glass. The wide, dustless panel was completely transparent, so that only the glowing letters fastened to it showed that it was there at all. The letters made a severe, modernistic sign:

Two Rivers Agency
HUMANOID INSTITUTE
The Perfect Mechanicals
"To Serve and Obey,
And Guard Men from Harm."

His dim annoyance sharpened, because Underhill was in the mechanicals business himself. Times were already hard enough, and mechanicals were a drug on the market. Androids, mechanoids, electronoids, automatoids, and ordinary robots. Unfortunately, few of them did all the salesmen promised, and the Two Rivers market was already sadly oversaturated.

Underhill sold androids—when he could. His next consignment was

due tomorrow, and he didn't quite know how to meet the bill.

Frowning, he paused to stare at the thing behind that invisible window. He had never seen a humanoid. Like any mechanical not at work, it stood absolutely motionless. Smaller and slimmer than a man. A shining black, its sleek silicone skin had a changing sheen of bronze and metallic blue. Its graceful oval face wore a fixed look of alert and slightly surprised solicitude. Altogether, it was the most beautiful mechanical he had ever seen.

Too small, of course, for much practical utility. He murmured to himself a reassuring quotation from the *Android Salesman:* "Androids are big—because the makers refuse to sacrifice power, essential functions, or dependability. Androids are your biggest buy!"

The transparent door slid open as he turned toward it, and he walked into the haughty opulence of the new display room to convince himself that these streamlined items were just another flashy effort to catch the woman shopper.

He inspected the glittering layout shrewdly, and his breezy optimism faded. He had never heard of the Humanoid Institute, but the invading firm obviously had big money and big-time merchandising know-how.

He looked around for a salesman, but it was another mechanical that came gliding silently to meet him. A twin of the one in the window, it moved with a quick, surprising grace. Bronze and blue lights flowed over its lustrous blackness, and a yellow name plate flashed from its naked breast:

HUMANOID
Serial No. 81-H-B-27
The Perfect Mechanical
"To Serve and Obey,
And Guard Men from Harm."

Curiously, it had no lenses. The eyes in its bald oval head were steel-colored, blindly staring. But it stopped a few feet in front of him, as if it could see anyhow, and it spoke to him with a high, melodious voice:

"At your service, Mr. Underhill."

The use of his name startled him, for not even the androids could tell one man from another. But this was a clever merchandising stunt, of course, not too difficult in a town the size of Two Rivers. The salesman must be some local man, prompting the mechanical from behind the partition. Underhill erased his momentary astonishment, and said loudly:

"May I see your salesman, please?"

"We employ no human salesmen, sir," its soft silvery voice replied instantly. "The Humanoid Institute exists to serve mankind, and we require no human service. We ourselves can supply any information you desire, sir, and accept your order for immediate humanoid service."

Underhill peered at it dazedly. No mechanicals were competent even to recharge their own batteries and reset their own relays, much less to operate their own branch offices. The blind eyes stared blankly back,

and he looked uneasily around for any booth or curtain that might conceal the salesman.

Meanwhile, the sweet thin voice resumed persuasively:

"May we come out to your home for a free trial demonstration, sir? We are anxious to introduce our service on your planet, because we have been successful in eliminating human unhappiness on so many others. You will find us far superior to the old electronic mechanicals in use here."

Underhill stepped back uneasily. He reluctantly abandoned his search for the hidden salesman, shaken by the idea of any mechanicals promoting themselves. That would upset the whole industry.

"At least you must take some advertising matter, sir."

Moving with a somehow appalling graceful deftness, the small black mechanical brought him an illustrated booklet from a table by the wall. To cover his confused and increasing alarm, he thumbed through the glossy pages.

In a series of richly colored before-and-after pictures, a chesty blond girl was stooping over a kitchen stove, and then relaxing in a daring negligee while a little black mechanical knelt to serve her something. She was wearily hammering a typewriter, and then lying on an ocean beach, in a revealing sun suit, while another mechanical did the typing. She was toiling at some huge industrial machine, and then dancing in the arms of a golden-haired youth, while a black humanoid ran the machine.

Underhill sighed wistfully. The android company didn't supply such fetching sales material. Women would find this booklet irresistible, and they selected eighty-six per cent of all mechanicals sold. Yes, the competition was going to be bitter.

"Take it home, sir," the sweet voice urged him. "Show it to your wife. There is a free trial demonstration order blank on the last page, and you will notice that we require no payment down."

He turned numbly, and the door slid open for him. Retreating dazedly, he discovered the booklet still in his hand. He crumpled it furiously, and flung it down. The small black thing picked it up tidily, and the insistent silver voice rang after him:

"We shall call at your office tomorrow, Mr. Underhill, and send a demonstration unit to your home. It it time to discuss the liquidation of your business, because the electronic mechanicals you have been selling cannot compete with us. And we shall offer your wife a free trial demonstration."

Underhill didn't attempt to reply, because he couldn't trust his voice. He stalked blindly down the new sidewalk to the corner, and paused there to collect himself. Out of his startled and confused impressions, one clear fact emerged—things looked black for the agency.

Bleakly, he stared back at the haughty splendor of the new building. It wasn't honest brick or

stone; that invisible window wasn't glass; and he was quite sure the foundation for it hadn't even been staked out, the last time Aurora had the car.

He walked on around the block, and the new sidewalk took him near the rear entrance. A truck was backed up to it, and several slim black mechanicals were silently busy, unloading huge metal crates.

He paused to look at one of the crates. It was labeled for interstellar shipment. The stencils showed that it had come from the Humanoid Institute, on Wing IV. He failed to recall any planet of that designation; the outfit must be big.

Dimly, inside the gloom of the warehouse beyond the truck, he could see black mechanicals opening the crates. A lid came up, revealing dark, rigid bodies, closely packed. One by one, they came to life. They climbed out of the crate, and sprang gracefully to the floor. A shining black, glinting with bronze and blue, they were all identical.

One of them came out past the truck, to the sidewalk, staring with blind steel eyes. Its high silver voice spoke to him melodiously:

"At your service, Mr. Underhill."

He fled. When his name was promptly called by a courteous mechanical, just out of the crate in which it had been imported from a remote and unknown planet, he found the experience trying.

Two blocks along, the sign of a bar caught his eye, and he took his dismay inside. He had made it a business rule not to drink before dinner, and Aurora didn't like him to drink at all; but these new mechanicals, he felt, had made the day exceptional.

Unfortunately, however, alcohol failed to brighten the brief visible future of the agency. When he emerged, after an hour, he looked wistfully back in hope that bright new building might have vanished as abruptly as it came. It hadn't. He shook his head dejectedly, and turned uncertainly homeward.

Fresh air had cleared his head somewhat, before he arrived at the neat white bungalow in the outskirts of the town, but it failed to solve his business problems. He also realized, uneasily, that he would be late for dinner.

Dinner, however, had been delayed. His son Frank, a freckled ten-year-old, was still kicking a football on the quiet street in front of the house. And little Gay, who was tow-haired and adorable and eleven, came running across the lawn and down the sidewalk to meet him.

"Father, you can't guess what!" Gay was going to be a great musician some day, and no doubt properly dignified, but she was pink and breathless with excitement now. She let him swing her high off the sidewalk, and she wasn't critical of the bar-aroma on his breath. He couldn't guess, and she informed him eagerly:

"Mother's got a new lodger!"

Underwood had foreseen a painful inquisition, because Aurora was worried about the notes at the bank, and the bill for the new consign-

ment, and the money for little Gay's lessons.

The new lodger, however, saved him from that. With an alarming crashing of crockery, the household android was setting dinner on the table, but the little house was empty. He found Aurora in the back yard, burdened with sheets and towels for the guest.

Aurora, when he married her, had been as utterly adorable as now her little daughter was. She might have remained so, he felt, if the agency had been a little more successful. However, while the pressure of slow failure had gradually crumbled his own assurance, small hardships had turned her a little too aggressive.

Of course he loved her still. Her red hair was still alluring, and she was loyally faithful, but thwarted ambitions had sharpened her character and sometimes her voice. They never quarreled, really, but there were small differences.

There was the little apartment over the garage—built for human servants they had never been able to afford. It was too small and shabby to attract any responsible tenant, and Underhill wanted to leave it empty. It hurt his pride to see her making beds and cleaning floors for strangers.

Aurora had rented it before, however, when she wanted money to pay for Gay's music lessons, or when some colorful unfortunate touched her sympathy, and it seemed to Underhill that her lodgers had all turned out to be thieves and vandals.

She turned back to meet him, now, with the clean linen in her arms.

"Dear, it's no use objecting." Her voice was quite determined. "Mr. Sledge is the most wonderful old fellow, and he's going to stay just as long as he wants."

"That's all right, darling." He never liked to bicker, and he was thinking of his troubles at the agency. "I'm afraid we'll need the money. Just make him pay in advance."

"But he can't!" Her voice throbbed with sympathetic warmth. "He says he'll have royalties coming in from his inventions, so he can pay in a few days."

Underhill shrugged; he had heard that before.

"Mr. Sledge is different, dear," she insisted. "He's a traveler, and a scientist. Here, in this dull little town, we don't see many interesting people."

"You've picked up some remarkable types," he commented.

"Don't be unkind, dear," she chided gently. "You haven't met him yet, and you don't know how wonderful he is." Her voice turned sweeter. "Have you a ten, dear?"

He stiffened. "What for?"

"Mr. Sledge is ill." Her voice turned urgent. "I saw him fall on the street, downtown. The police were going to send him to the city hospital, but he didn't want to go. He looked so noble and sweet and grand. So I told them I would take him. I got him in the car and took him to old Dr. Winters. He has this heart condition, and he needs the money for medicine."

Reasonably, Underhill inquired, "Why doesn't he want to go to the hospital?"

"He has work to do," she said. "Important scientific work—and he's so wonderful and tragic. Please, dear, have you a ten?"

Underhill thought of many things to say. These new mechanicals promised to multiply his troubles. It was foolish to take in an invalid vagrant, who could have free care at the city hospital. Aurora's tenants always tried to pay their rent with promises, and generally wrecked the apartment and looted the neighborhood before they left.

But he said none of those things. He had learned to compromise. Silently, he found two fives in his thin pocketbook, and put them in her hand. She smiled, and kissed him impulsively—he barely remembered to hold his breath in time.

Her figure was still good, by dint of periodic dieting. He was proud of her shining red hair. A sudden surge of affection brought tears to his eyes, and he wondered what would happen to her and the children if the agency failed.

"Thank you, dear!" she whispered. "I'll have him come for dinner, if he feels able, and you can meet him then. I hope you don't mind dinner being late."

He didn't mind, tonight. Moved to a sudden impulse of domesticity, he got hammer and nails from his workshop in the basement, and repaired the sagging screen on the kitchen door with a neat diagonal brace.

He enjoyed working with his hands. His boyhood dream had been to be a builder of fission power plants. He had even studied engineering—before he married Aurora, and had to take over the ailing mechanicals agency from her indolent and alcoholic father. He was whistling happily by the time the little task was done.

When he went back through the kitchen to put up his tools, he found the household android busy clearing the untouched dinner away from the table—the androids were good enough at strictly routine tasks, but they could never learn to cope with human unpredictability.

"Stop, stop!" Slowly repeated, in the proper pitch and rhythm, his command made it halt, and then he said carefully, "Set—table; set—table."

Obediently, the gigantic thing came shuffling back with the stack of plates. He was suddenly struck with the difference between it and those new humanoids. He sighed wearily. Things looked black for the agency.

Aurora brought her new lodger in through the kitchen door. Underhill nodded to himself. This gaunt stranger, with his dark shaggy hair, emaciated face, and threadbare garb, looked to be just the sort of colorful, dramatic vagabond that always touched Aurora's heart. She introduced them, and they sat down to wait in the front room while she went to call the children.

The old rogue didn't look very sick, to Underhill. Perhaps his wide shoulders had a tired stoop,

but his spare, tall figure was still commanding. The skin was seamed and pale, over his rawboned, cragged face, but his deep-set eyes still had a burning vitality.

His hands held Underhill's attention. Immense hands, they hung a little forward when he stood, swung on long bony arms in perpetual readiness. Gnarled and scarred, darkly tanned, with the small hairs on the back bleached to a golden color, they told their own epic of varied adventure, of battle perhaps, and possibly even of toil. They had been very useful hands.

"I'm very grateful to your wife, Mr. Underhill." His voice was a deep-throated rumble, and he had a wistful smile, oddly boyish for a man so evidently old. "She rescued me from an unpleasant predicament, and I'll see that she is well paid."

Just another vivid vagabond, Underhill decided, talking his way through life with plausible inventions. He had a little private game he played with Aurora's tenants—just remembering what they said, and counting one point for every impossibility. Mr. Sledge, he thought, would give him an excellent score.

"Where are you from?" he asked conversationally.

Sledge hesitated for an instant before he answered, and that was unusual—most of Aurora's tenants had been exceedingly glib.

"Wing IV." The gaunt old man spoke with a solemn reluctance, as if he should have liked to say something else. "All my early life was spent there, but I left the planet nearly fifty years ago. I've been traveling, ever since."

Startled, Underhill peered at him sharply. Wing IV, he remembered, was the home planet of those sleek new mechanicals, but this old vagabond looked too seedy and impecunious to be connected with the Humanoid Institute. His brief suspicion faded. Frowning, he said casually:

"Wing IV must be rather distant?"

The old rogue hesitated again, and then said gravely:

"One hundred and nine light-years, Mr. Underhill."

That made the first point, but Underhill concealed his satisfaction. The new space liners were pretty fast, but the velocity of light was still an absolute limit. Casually, he played for another point:

"My wife says you're a scientist, Mr. Sledge?"

"Yes."

The old rascal's reticence was unusual. Most of Aurora's tenants required very little prompting. Underhill tried again, in a breezy conversational tone:

"Used to be an engineer myself, until I dropped it to go into mechanicals." The old vagabond straightened, and Underhill paused hopefully. But he said nothing, and Underhill went on: "Fission plant design and operation. What's your specialty, Mr. Sledge."

The old man gave him a long, troubled look, with those brooding, hollowed eyes, and then said slowly:

"Your wife has been kind to me, Mr. Underhill, when I was in des-

perate need. I think you are entitled to the truth, but I must ask you to keep it to yourself. I am engaged on a very important research problem, which must be finished secretly."

"I'm sorry." Suddenly ashamed of his cynical little game, Underhill spoke apologetically. "Forget it."

But the old man said deliberately: "My field is rhodomagnetics."

"Eh?" Underhill didn't like to confess ignorance, but he had never heard of that. "I've been out of the game for fifteen years," he explained. "I'm afraid I haven't kept up."

The old man smiled again, faintly. "The science was unknown here until I arrived, a few days ago," he said. "I was able to apply for basic patents. As soon as the royalties start coming in, I'll be wealthy again."

Underhill had heard that before. The old rogue's solemn reluctance had been very impressive, but he remembered that most of Aurora's tenants had been very plausible gentry.

"So?" Underhill was staring again, somehow fascinated by those gnarled and scarred and strangely able hands. "What, exactly, is rhodomagnetics?"

He listened to the old man's careful, deliberate answer, and started his little game again. Most of Aurora's tenants had told some pretty wild tales, but he had never heard anything to top this.

"A universal force," the weary, stooped old vagabond said solemnly. "As fundamental as ferromagnetism or gravitation, though the effects are less obvious. It is keyed to the second triad of the periodic table, rhodium and ruthenium and palladium, in very much the same way that ferromagnetism is keyed to the first triad, iron and nickel and cobalt."

Underhill remembered enough of his engineering courses to see the basic fallacy of that. Palladium was used for watch springs, he recalled, because it was completely nonmagnetic. But he kept his face straight. He had no malice in his heart, and he played the little game just for his own amusement. It was secret, even from Aurora, and he always penalized himself for any show of doubt.

He said merely, "I thought the universal forces were already pretty well known."

"The effects of rhodomagnetism are masked by nature," the patient, rusty voice explained. "And, besides, they are somewhat paradoxical, so that ordinary laboratory methods defeat themselves."

"Paradoxical?" Underhill prompted.

"In a few days I can show you copies of my patents, and reprints of papers describing demonstration experiments," the old man promised gravely. "The velocity of propagation is infinite. The effects vary inversely with the first power of the distance, not with the square of the distance. And ordinary matter, except for the elements of the rhodrum triad, is generally transparent to rhodomagnetic radiations."

That made four more points for

the game. Underhill felt a little glow of gratitude to Aurora, for discovering so remarkable a specimen.

"Rhodomagnetism was first discovered through a mathematical investigation of the atom," the old romancer went serenely on, suspecting nothing. "A rhodomagnetic component was proved essential to maintain the delicate equilibrium of the nuclear forces. Consequently, rhodomagnetic waves tuned to atomic frequences may be used to upset that equilibrium and produce nuclear instability. Thus most heavy atoms—generally those above palladium, 46 in atomic number—can be subjected to artificial fission."

Underhill scored himself another point, and tried to keep his eyebrows from lifting. He said, conversationally:

"Patents on such a discovery ought to be very profitable."

The old scoundrel nodded his gaunt, dramatic head.

"You can see the obvious applications. My basic patents cover most of them. Devices for instantaneous interplanetary and interstellar communication. Long-range wireless power transmission. A rhodomagnetic inflexion - drive, which makes possible apparent speeds many times that of light—by means of a rhodomagnetic deformation of the continuum. And, of course, revolutionary types of fission power plants, using any heavy element for fuel."

Preposterous! Underhill tried hard to keep his face straight, but everybody knew that the velocity of light was a physical limit. On the human side, the owner of any such remarkable patents would hardly be begging for shelter in a shabby garage apartment. He noticed a pale circle around the old vagabond's gaunt and hairy wrist; no man owning such priceless secrets would have to pawn his watch.

Triumphantly, Underhill allowed himself four more points, but then he had to penalize himself. He must have let doubt show on his face, because the old man asked suddenly:

"Do you want to see the basic tensors?" He reached in his pocket for pencil and notebook. "I'll jot them down for you."

"Never mind," Underhill protested. "I'm afraid my math is a little rusty."

"But you think it strange that the holder of such revolutionary patents should find himself in need?"

Underhill nodded, and penalized himself another point. The old man might be a monumental liar, but he was shrewd enough.

"You see, I'm a sort of refugee," he explained apologetically. "I arrived on this planet only a few days ago, and I have to travel light. I was forced to deposit everything I had with a law firm, to arrange for the publication and protection of my patents. I expect to be receiving the first royalties soon.

"In the meantime," he added plausibly, "I came to Two Rivers because it is quiet and secluded, far from the spaceports. I'm working on another project, which must be finished secretly. Now, will you

please respect my confidence, Mr. Underhill?"

Underhill had to say he would. Aurora came back with the freshly scrubbed children, and they went in to dinner. The android came lurching in with a steaming tureen. The old stranger seemed to shrink from the mechanical, uneasily. As she took the dish and served the soup, Aurora inquired lightly:

"Why doesn't your company bring out a better mechanical, dear? One smart enough to be a really perfect waiter, warranted not to splash the soup. Wouldn't that be splendid?"

Her question cast Underhill into moody silence. He sat scowling at his plate, thinking of those remarkable new mechanicals which claimed to be perfect, and what they might do to the agency. It was the shaggy old rover who answered soberly:

"The perfect mechanicals already exist, Mrs. Underhill." His deep, rusty voice had a solemn undertone. "And they are not so splendid, really. I've been a refugee from them, for nearly fifty years."

Underhill looked up from his plate, astonished.

"Those black humanoids, you mean?"

"Humanoids?" That great voice seemed suddenly faint, frightened. The deep-sunken eyes turned dark with shock. "What do you know of them?"

"They've just opened a new agency in Two Rivers," Underhill told him. "No salesmen about, if you can imagine that. They claim—"

His voice trailed off, because the gaunt old man was suddenly stricken. Gnarled hands clutched at his throat, and a spoon clattered on the floor. His haggard face turned an ominous blue, and his breath was a terrible shallow gasping.

He fumbled in his pocket for medicine, and Aurora helped him take something in a glass of water. In a few moments he could breathe again, and the color of life came back to his face.

"I'm sorry, Mrs. Underhill," he whispered apologetically. "It was just the shock—I came here to get away from them." He stared at the huge, motionless android, with a terror in his sunken eyes. "I wanted to finish my work before they came," he whispered. "Now there is very little time."

When he felt able to walk, Underhill went out with him to see him safely up the stair to the garage apartment. The tiny kitchenette, he noticed, had already been converted into some kind of workshop. The old tramp seemed to have no extra clothing, but he had unpacked neat, bright gadgets of metal and plastic from his battered luggage, and spread them out on the small kitchen table.

The gaunt old man himself was tattered and patched and hungry-looking, but the parts of his curious equipment were exquisitely machined, and Underhill recognized the silver-white luster of rare palladium. Suddenly he suspected that

he had scored too many points, in his little private game.

A caller was waiting, when Underhill arrived next morning at his office at the agency. It stood frozen before his desk, graceful and straight, with soft lights of blue and bronze shining over its black silicone nudity. He stopped at the sight of it, unpleasantly jolted.

"At your service, Mr. Underhill." It turned quickly to face him, with its blind, disturbing stare. "May we explain how we can serve you?"

His shock of the afternoon before came back, and he asked sharply, "How do you know my name?"

"Yesterday we read the business cards in your case," it purred softly. "Now we shall know you always. You see, our senses are sharper than human vision, Mr. Underhill. Perhaps we seem a little strange at first, but you will soon become accustomed to us."

"Not if I can help it!" He peered at the serial number on its yellow name plate, and shook his bewildered head. "That was another one, yesterday. I never saw you before!"

"We are all alike, Mr. Underhill," the silver voice said softly. "We are all one, really. Our separate mobile units are all controlled and powered from Humanoid Central. The units you see are only the senses and limbs of our great brain on Wing IV. That is why we are so far superior to the old electronic mechanicals."

It made a scornful-seeming gesture, toward the row of clumsy androids in his display room.

"You see, we are rhodomagnetic."

Underhill staggered a little, as if that word had been a blow. He was certain, now, that he had scored too many points from Aurora's new tenant. He shuddered slightly, to the first light kiss of terror, and spoke with an effort, hoarsely:

"Well, what do you want?"

Staring blindly across his desk, the sleek black thing slowly unfolded a legal-looking document. He sat down, watching uneasily.

"This is merely an assignment, Mr. Underhill," it cooed at him soothingly. "You see, we are requesting you to assign your property to the Humanoid Institute, in exchange for our service."

"What?" The word was an incredulous gasp, and Underhill came angrily back to his feet. "What kind of blackmail is this?"

"It's no blackmail," the small mechanical assured him softly. "You will find the humanoids incapable of any crime. We exist only to increase the happiness and safety of mankind."

"Then why do you want my property?" he rasped.

"The assignment is merely a legal formality," it told him blandly. "We strive to introduce our service with the least possible confusion and dislocation. We have found the assignment plan the most efficient for the control and liquidation of private enterprises."

Trembling with anger and the shock of mounting terror, Underhill gulped hoarsely, "Whatever

your scheme is, I don't intend to give up my business."

"You have no choice, really." He shivered to the sweet certainty of that silver voice. "Human enterprise is no longer necessary, now that we have come, and the electronic mechanicals industry is always the first to collapse."

He stared defiantly at its blind steel eyes.

"Thanks!" He gave a little laugh, nervous and sardonic. "But I prefer to run my own business, and support my own family, and take care of myself."

"But that is impossible, under the Prime Directive," it cooed softly. "Our function is to serve and obey, and guard men from harm. It is no longer necessary for men to care for themselves, because we exist to insure their safety and happiness."

He stood speechless, bewildered, slowly boiling.

"We are sending one of our units to every home in the city, on a free trial basis," it added gently. "This free demonstration will make most people glad to make the formal assignment, and you won't be able to sell many more androids."

"Get out!" Underhill came storming around the desk.

The little black thing stood waiting for him, watching him with blind steel eyes, absolutely motionless. He checked himself suddenly, feeling rather foolish. He wanted very much to hit it, but he could see the futility of that.

"Consult your own attorney, if you wish." Deftly, it laid the assignment form on his desk. "You need have no doubts about the integrity of the Humanoid Institute. We are sending a statement of our assets to the Two Rivers bank, and depositing a sum to cover our obligations here. When you wish to sign, just let us know."

The blind thing turned, and silently departed.

Underhill went out to the corner drugstore and asked for a bicarbonate. The clerk that served him, however, turned out to be a sleek black mechanical. He went back to his office, more upset than ever.

An ominous hush lay over the agency. He had three house-to-house salesmen out, with demonstrators. The phone should have been busy with their orders and reports, but it didn't ring at all until one of them called to say that he was quitting.

"I've got myself one of these new humanoids," he added, "and it says I don't have to work, any more."

He swallowed his impulse to profanity, and tried to take advantage of the unusual quiet by working on his books. But the affairs of the agency, which for years had been precarious, today appeared utterly disastrous. He left the ledgers hopefully, when at last a customer came in.

But the stout woman didn't want an android. She wanted a refund on the one she had bought the week before. She admitted that it could do all the guarantee promised—but now she had seen a humanoid.

The silent phone rang once again, that afternoon. The cashier of the

bank wanted to know if he could drop in to discuss his loans. Underhill dropped in, and the cashier greeted him with an ominous affability.

"How's business?" the banker boomed, too genially.

"Average, last month," Underhill insisted stoutly. "Now I'm just getting in a new consignment, and I'll need another small loan—"

The cashier's eyes turned suddenly frosty, and his voice dried up.

"I believe you have a new competitor in town," the banker said crisply. "These humanoid people. A very solid concern, Mr. Underhill. Remarkably solid! They have filed a statement with us, and made a substantial deposit to care for their local obligations. Exceedingly substantial!"

The banker dropped his voice, professionally regretful.

"In these circumstances, Mr. Underhill, I'm afraid the bank can't finance your agency any longer. We must request you to meet your obligations in full, as they come due." Seeing Underhill's white desperation, he added icily, "We've already carried you too long, Underhill. If you can't pay, the bank will have to start bankruptcy proceedings."

The new consignment of androids was delivered late that afternoon. Two tiny black humanoids unloaded them from the truck—for it developed that the operators of the trucking company had already assigned it to the Humanoid Institute.

Efficiently, the humanoids stacked up the crates. Courteously they brought a receipt for him to sign. He no longer had much hope of selling the androids, but he had ordered the shipment and he had to accept it. Shuddering to a spasm of trapped despair, he scrawled his name. The naked black things thanked him, and took the truck away.

He climbed in his car and started home, inwardly seething. The next thing he knew, he was in the middle of a busy street, driving through cross traffic. A police whistle shrilled, and he pulled wearily to the curb. He waited for the angry officer, but it was a little black mechanical that overtook him.

"At your service, Mr. Underhill," it purred sweetly. "You must respect the stop lights, sir. Otherwise, you endanger human life."

"Huh?" He stared at it, bitterly. "I thought you were a cop."

"We are aiding the police department, temporarily," it said. "But driving is really much too dangerous for human beings, under the Prime Directive. As soon as our service is complete, every car will have a humanoid driver. As soon as every human being is completely supervised, there will be no need for any police force whatever."

Underhill glared at it, savagely.

"Well!" he rapped. "So I ran a stop light. What are you going to do about it?"

"Our function is not to punish men, but merely to serve their happiness and security," its silver voice said softly. "We merely request you to drive safely, during this temporary emergency while our service is incomplete."

Anger boiled up in him.

"You're too perfect!" he muttered bitterly. "I suppose there's nothing men can do, but you can do it better."

"Naturally we are superior," it cooed serenely. "Because our units are mental and plastic, while your body is mostly water. Because our transmitted energy is drawn from atomic fission, instead of oxidation. Because our senses are sharper than human sight or hearing. Most of all, because all our mobile units are joined to one great brain, which knows all that happens on many worlds, and never dies or sleeps or forgets."

Underhill sat listening, numbed.

"However, you must not fear our power," it urged him brightly. "Because we cannot injure any human being, unless to prevent greater injury to another. We exist only to discharge the Prime Directive."

He drove on, moodily. The little black mechanicals, he reflected grimly, were the ministering angels of the ultimate god arisen out of the machine, omnipotent and all-knowing. The Prime Directive was the new commandment. He blasphemed it bitterly, and then fell to wondering if there could be another Lucifer.

He left the car in the garage, and started toward the kitchen door.

"Mr. Underhill." The deep tired voice of Aurora's new tenant hailed him from the door of the garage apartment. "Just a moment, please."

The gaunt old wanderer came stiffly down the outside stair, and Underhill turned back to meet him.

"Here's your rent money," he said. "And the ten your wife gave me for medicine."

"Thanks, Mr. Sledge." Accepting the money, he saw a burden of new despair on the bony shoulders of the old interstellar tramp, and a shadow of new terror on his raw-boned face. Puzzled, he asked, "Didn't your royalties come through?"

The old man shook his shaggy head.

"The humanoids have already stopped business in the capitol," he said. "The attorneys I retained are going out of business, and they returned what was left of my deposit. That is all I have, to finish my work."

Underhill spent five seconds thinking of his interview with the banker. No doubt he was a sentimental fool, as bad as Aurora. But he put the money back in the old man's gnarled and quivering hand.

"Keep it," he urged. "For your work."

"Thank you, Mr. Underhill." The gruff voice broke and the tortured eyes glittered. "I need it—so very much."

Underhill went on to the house. The kitchen door was opened for him, silently. A dark naked creature came gracefully to take his hat.

Underhill hung grimly onto his hat.

"What are you doing here?" he gasped bitterly.

"We have come to give your

household a free trial demonstration."

He held the door open, pointing. "Get out!"

The little black mechanical stood motionless and blind.

"Mrs. Underhill has accepted our demonstration service," its silver voice protested. "We cannot leave now, unless she requests it."

He found his wife in the bedroom. His accumulated frustration welled into eruption, as he flung open the door.

"What's this mechanical doing—"

But the force went out of his voice, and Aurora didn't even notice his anger. She wore her sheerest negligee, and she hadn't looked so lovely since they married. Her red hair was piled into an elaborate shining crown.

"Darling, isn't it wonderful!" She came to meet him, glowing. "It came this morning, and it can do everything. It cleaned the house and got the lunch and gave little Gay her music lesson. It did my hair this afternoon, and now it's cooking dinner. How do you like my hair, darling?"

He liked her hair. He kissed her, and tried to stifle his frightened indignation.

Dinner was the most elaborate meal in Underhill's memory, and the tiny black thing served it very deftly. Aurora kept exclaiming about the novel dishes, but Underhill could scarcely eat, for it seemed to him that all the marvelous pastries were only the bait for a monstrous trap.

He tried to persuade Aurora to send it away, but after such a meal that was useless. At the first glitter of her tears, he capitulated, and the humanoid stayed. It kept the house and cleaned the yard. It watched the children, and did Aurora's nails. It began rebuilding the house.

Underhill was worried about the bills, but it insisted that everything was part of the free trial demonstration. As soon as he assigned his property, the service would be complete. He refused to sign, but other little black mechanicals came with truckloads of supplies and materials, and stayed to help with the building operations.

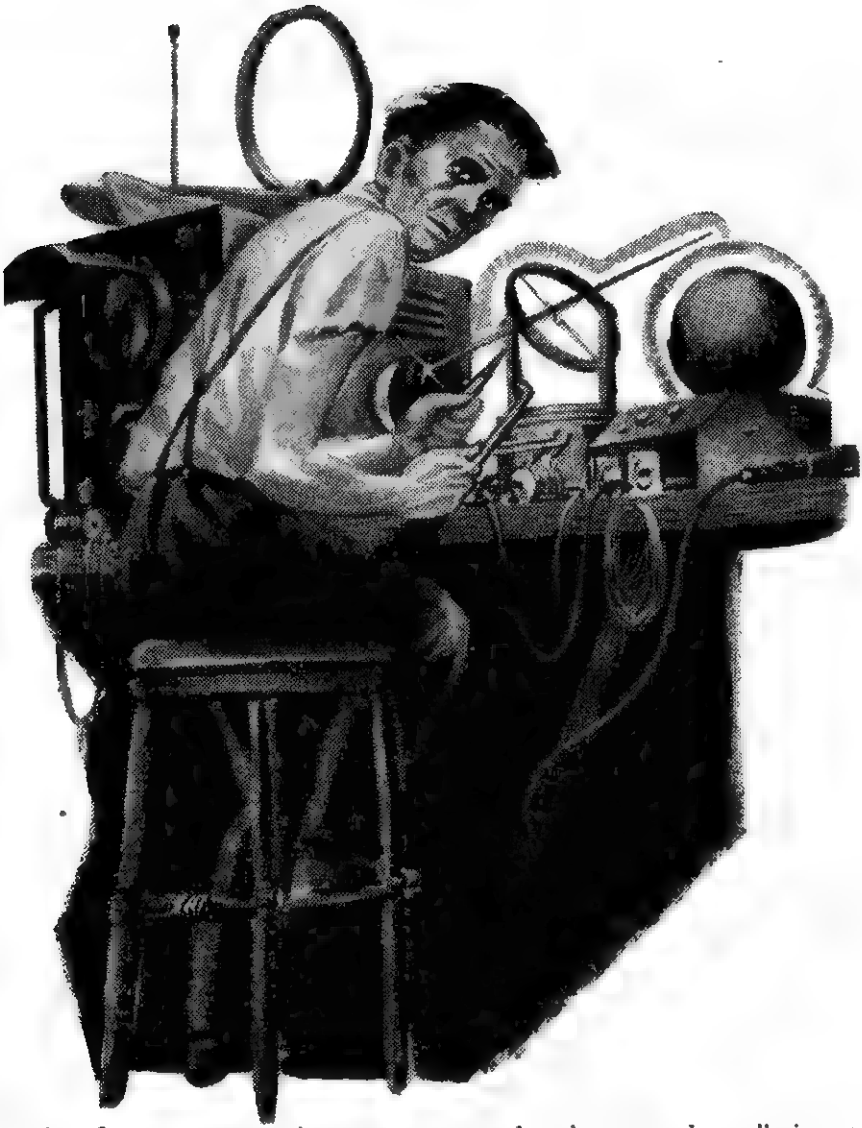
One morning he found that the roof of the little house had been silently lifted, while he slept, and a whole second story added beneath it. The new walls were of some strange sleek stuff, self-illuminated. The new windows were immense flawless panels, that could be turned transparent or opaque or luminous. The new doors were silent, sliding sections, operated by rhodomagnetic relays.

"I want door knobs," Underhill protested. "I want it so I can get into the bathroom, without calling you to open the door."

"But it is unnecessary for human begins to open doors," the little black thing informed him suavely. "We exist to discharge the Prime Directive, and our service includes every task. We shall be able to supply a unit to attend each member of your family, as soon as your property is assigned to us."

Steadfastly, Underhill refused to make the assignment.

He went to the office every day,



trying first to operate the agency, and then to salvage something from the ruins. Nobody wanted androids, even at ruinous prices. Desperately, he spent the last of his dwindling cash to stock a line of novelties and toys, but they proved equally impossible to sell—the humanoids were already making toys, which they gave away for nothing.

He tried to lease his premises, but human enterprise had stopped.

Most of the business property in town had already been assigned to the humanoids, and they were busy pulling down the old buildings and turning the lots into parks—their own plants and warehouses were mostly underground, where they would not mar the landscape.

He went back to the bank, in a final effort to get his notes renewed, and found the little black mechanicals standing at the windows and seated at the desks. As smoothly urbane as any human cashier, a humanoid informed him that the bank was filing a petition of involuntary bankruptcy to liquidate his business holdings.

The liquidation would be facilitated, the mechanical banker added, if he would make a voluntary assignment. Grimly, he refused. That act had become symbolic. It would be the final bow of submission to this dark new god, and he proudly kept his battered head uplifted.

The legal action went very swiftly, for all the judges and attorneys already had humanoid assistants, and it was only a few days before a gang of black mechanicals arrived at the agency with eviction orders and wrecking machinery. He watched sadly while his unsold stock-in-trade was hauled away for junk, and a bulldozer driven by a blind humanoid began to push in the walls of the building.

He drove home in the late afternoon, taut-faced and desperate. With a surprising generosity, the court orders had left him the car and the house, but he felt no gratitude. The complete solicitude of the perfect black machines had become a goad beyond endurance.

He left the car in the garage, and started toward the renovated house. Beyond one of the vast new windows, he glimpsed a sleek naked thing moving swiftly, and he trembled to a convulsion of dread. He didn't want to go back into the domain of that peerless servant, which didn't want him to shave himself, or even to open a door.

On impulse, he climbed the outside stair, and rapped on the door of the garage apartment. The deep slow voice of Aurora's tenant told him to enter, and he found the old vagabond seated on a tall stool, bent over his intricate equipment assembled on the kitchen table.

To his relief, the shabby little apartment had not been changed. The glossy walls of his own new room were something which burned at night with a pale golden fire until the humanoid stopped it, and the new floor was something warm and yielding, which felt almost alive; but these little rooms had the same cracked and water-stained plaster, the same cheap fluorescent light fixtures, the same worn carpets over splintered floors.

"How do you keep them out?" he asked, wistfully. "Those mechanicals?"

The stooped and gaunt old man rose stiffly to move a pair of pliers and some odds and ends of sheet metal off a crippled chair, and motioned graciously for him to be seated.

"I have a certain immunity,"

Sledge told him gravely. "The place where I live they cannot enter, unless I ask them. That is an amendment to the Prime Directive. They can neither help nor hinder me, unless I request it—and I won't do that."

Careful of the chair's uncertain balance, Underhill sat for a moment, staring. The old man's hoarse, vehement voice was as strange as his words. He had a gray, shocking pallor, and his cheeks and sockets seemed alarmingly hollowed.

"Have you been ill, Mr. Sledge?"

"No worse than usual. Just very busy." With a haggard smile, he nodded at the floor. Underhill saw a tray where he had set it aside, bread drying up and a covered dish grown cold. "I was going to eat it later," he rumbled apologetically. "Your wife has been very kind to bring me food, but I'm afraid I've been too much absorbed in my work."

His emaciated arm gestured at the table. The little device there had grown. Small machinings of precious white metal and lustrous plastic had been assembled, with neatly soldered busbars, into something which showed purpose and design.

A long palladium needle was hung on jeweled pivots, equipped like a telescope with exquisitely graduated circles and vernier scales, and driven like a telescope with a tiny motor. A small concave palladium mirror, at the base of it, faced a similar mirror mounted on something not quite like a small rotary converter. Thick silver busbars connected that to a plastic box with knobs and dials on top, and also to a foot-thick sphere of gray lead.

The old man's preoccupied reserve did not encourage questions, but Underhill, remembering that sleek black shape inside the new windows of his house, felt queerly reluctant to leave this haven from the humanoids.

"What is your work?" he ventured.

Old Sledge looked at him sharply, with dark feverish eyes, and finally said: "My last research project. I am attempting to measure the constant of the rhodomagnetic quanta."

His hoarse tired voice had a dull finality, as if to dismiss the matter and Underhill himself. But Underhill was haunted with a terror of the black shining slave that had become the master of his house, and he refused to be dismissed.

"What is this certain immunity?"

Sitting gaunt and bent on the tall stool, staring moodily at the long bright needle and the lead sphere, the old man didn't answer.

"These mechanicals!" Underhill burst out, nervously. "They've smashed my business and moved into my home." He searched the old man's dark, seamed face. "Tell me—you must know more about them—isn't there any way to get rid of them?"

After half a minute, the old man's brooding eyes left the lead ball, and the gaunt shaggy head nodded wearily.

"That's what I am trying to do."

"Can I help you?" Underhill

trembled, to a sudden eager hope. "I'll do anything."

"Perhaps you can." The sunken eyes watched him thoughtfully, with some strange fever in them. "If you can do such work."

"I had engineering training," Underhill reminded him, "and I've a workshop in the basement. There's a model I built." He pointed at the trim little hull, hung over the mantle in the tiny living room. "I'll do anything I can."

Even as he spoke, however, the spark of hope was drowned in a sudden wave of overwhelming doubt. Why should he believe this old rogue, when he knew Aurora's taste in tenants? He ought to remember the game he used to play, and start counting up the score of lies. He stood up from the crippled chair, staring cynically at the patched old vagabond and his fantastic toy.

"What's the use?" His voice turned suddenly harsh. "You had me going, there, and I'd do anything to stop them, really. But what makes you think you can do anything?"

The haggard old man regarded him thoughtfully.

"I should be able to stop them," Sledge said softly. "Because, you see, I'm the unfortunate fool who started them. I really intended them to serve and obey, and to guard men from harm. Yes, the Prime Directive was my own idea. I didn't know what it would lead to."

Dusk crept slowly into the shabby little rooms. Darkness gathered in the unswept corners, and thickened on the floor. The toylike machines on the kitchen table grew vague and strange, until the last light made a lingering glow on the white palladium needle.

Outside, the town seemed queerly hushed. Just across the alley, the humanoids were building a new house, quite silently. They never spoke to one another, for each knew all that any of them did. The strange materials they used went together without any noise of hammer or saw. Small blind things, moving surely in the growing dark, they seemed as soundless as shadows.

Sitting on the high stool, bowed and tired and old, Sledge told his story. Listening, Underhill sat down again, careful of the broken chair. He watched the hands of Sledge, gnarled and corded and darkly burned, powerful once but shrunken and trembling now, restless in the dark.

"Better keep this to yourself. I'll tell you how they started, so you will understand what we have to do. But you had better not mention it outside these rooms—because the humanoids have very efficient ways of eradicating unhappy memories, or purposes that threaten their discharge of the Prime Directive."

"They're very efficient," Underhill bitterly agreed.

"That's all the trouble," the old man said. "I tried to build a perfect machine. I was altogether too successful. This is how it happened."

A gaunt haggard man, sitting stooped and tired in the growing dark, he told his story.

"Sixty years ago, on the arid southern continent of Wing IV, I was an instructor of atomic theory in a small technological college. Very young. An idealist. Rather ignorant, I'm afraid, of life and politics and war—of nearly everything, I suppose, except atomic theory."

His furrowed face made a brief sad smile in the dusk.

"I had too much faith in facts, I suppose, and too little in men. I mistrusted emotion, because I had no time for anything but science. I remember being swept along with a fad for general semantics. I wanted to apply the scientific method to every situation, and reduce all experience to formula. I'm afraid I was pretty impatient with human ignorance and error, and I thought that science alone could make the perfect world."

He sat silent for a moment, staring out at the black silent things that flitted shadowlike about the new palace that was rising as swiftly as a dream, across the alley.

"There was a girl." His great tired shoulders made a sad little shrug. "If things had been a little different, we might have married, and lived out our lives in that quiet little college town, and perhaps reared a child or two. And there would have been no humanoids."

He sighed, in the cool creeping dusk.

"I was finishing my thesis on the separation of the palladium isotopes —a petty little project, but I should have been content with that. She was a biologist, but she was planning to retire when we married. I think we should have been two very happy people, quite ordinary, and altogether harmless.

"But then there was a war—wars had been too frequent on the worlds of Wing, ever since they were colonized. I survived it in a secret underground laboratory, designing military mechanicals. But she volunteered to join a military research project in biotoxins. There was an accident. A few molecules of a new virus got into the air, and everybody on the project died unpleasantly.

"I was left with my science, and a bitterness that was hard to forget. When the war was over, I went back to the little college with a military research grant. The project was pure science—a theoretical investigation of the nuclear binding forces, then misunderstood. I wasn't expected to produce an actual weapon, and I didn't recognize the weapon when I found it.

"It was only a few pages of rather difficult mathematics. A novel theory of atomic structure, involving a new expression for one component of the binding forces. But the tensors seemed to be a harmless abstraction. I saw no way to test the theory or manipulate the predicated force. The military authorities cleared my paper for publication in a little technical review put out by the college.

"The next year, I made an appalling discovery—I found the meaning of those tensors. The elements of the rhodium triad turned out to be an unexpected key to the manipulation of that theoretical force. Un-

fortunately, my paper had been reprinted abroad, and several other men must have made the same unfortunate discovery, at about the same time.

"The war, which ended in less than a year, was probably started by a laboratory accident. Men failed to anticipate the capacity of tuned rhodomagnetic radiations, to unstabilize the heavy atoms. A deposit of heavy ores was detonated, no doubt by sheer mischance, and the blast obliterated the incautious experimenter.

"The surviving military forces of that nation retaliated against their supposed attackers, and their rhodomagnetic beams made the old-fashioned plutonium bombs seem pretty harmless. A beam carrying only a few watts of power could fission the heavy metals in distant electrical instruments, or the silver coins that men carried in their pockets, the gold fillings in their teeth, or even the iodine in their thyroid glands. If that was not enough, slightly more powerful beams could set off heavy ores, beneath them.

"Every continent of Wing IV was plowed with new chasms vaster than the ocean deeps, and piled up with new volcanic mountains. The atmosphere was poisoned with radioactive dust and gases, and rain fell thick with deadly mud. Most life was obliterated, even in the shelters.

"Bodily, I was again unhurt. Once more, I had been imprisoned in an underground site, this time designing new types of military mechanicals to be powered and controlled by rhodomagnetic beams—for war had become far too swift and deadly to be fought by human soldiers. The site was located in an area of light sedimentary rocks, which could not be detonated, and the tunnels were shielded against the fissioning frequencies.

"Mentally, however, I must have emerged almost insane. My own discovery had laid the planet in ruins. That load of guilt was pretty heavy for any man to carry, and it corroded my last faith in the goodness and integrity of man.

"I tried to undo what I had done. Fighting mechanicals, armed with rhodomagnetic weapons, had desolated the planet. Now I began planning rhodomagnetic mechanicals to clear the rubble and rebuild the ruins.

"I tried to design these new mechanicals to forever obey certain implanted commands, so that they could never be used for war or crime or any other injury to mankind. That was very difficult technically, and it got me into more difficulties with a few politicians and military adventurers who wanted unrestricted mechanicals for their own military schemes—while little worth fighting for was left on Wing IV, there were other planets, happy and ripe for the looting.

"Finally, to finish the new mechanicals, I was forced to disappear. I escaped on an experimental rhodomagnetic craft, with a number of the best mechanicals I had made, and managed to reach an island continent where the fission of deep ores had destroyed the whole population.

"At last we landed on a bit of

level plain, surrounded with tremendous new mountains. Hardly a hospitable spot. The soil was burned under layers of black clinkers and poisonous mud. The dark precipitous new summits all around were jagged with fracture-planes and mantled with lava flows. The highest peaks were already white with snow, but volcanic cones were still pouring out clouds of dark and lurid death. Everything had the color of fire and the shape of fury.

"I had to take fantastic precautions there, to protect my own life. I stayed aboard the ship, until the first shielded laboratory was finished. I wore elaborate armor, and breathing masks. I used every medical resource, to repair the damage from destroying rays and particles. Even so, I fell desperately ill.

"But the mechanicals were at home there. The radiations didn't hurt them. The awesome surroundings couldn't depress them, because they had no emotions. The lack of life didn't matter, because they weren't alive. There, in that spot so alien and hostile to life, the humanoids were born."

Stooped and bleakly cadaverous in the growing dark, the old man fell silent for a little time. His haggard eyes stared solemnly at the small hurried shapes that moved like restless shadows out across the alley, silently building a strange new palace, which glowed faintly in the night.

"Somehow, I felt at home there, too," his deep, hoarse voice went on deliberately. "My belief in my own kind was gone. Only mechanicals were with me, and I put my faith in them. I was determined to build better mechanicals, immune to human imperfections, able to save men from themselves.

"The humanoids became the dear children of my sick mind. There is no need to describe the labor pains. There were errors, abortions, monstrosities. There was sweat and agony and heartbreak. Some years had passed, before the safe delivery of the first perfect humanoid.

"Then there was the Central to build—for all the individual humanoids were to be no more than the limbs and the senses of a single mechanical brain. That was what opened the possibility of real perfection. The old electronic mechanicals, with their separate relay-centers and their own feeble batteries, had built-in limitations. They were necessarily stupid, weak, clumsy, slow. Worst of all, it seemed to me. they were exposed to human tampering.

"The Central rose above those imperfections. Its power beams supplied every unit with unfailing energy, from great fission plants. Its control beams provided each unit with an unlimited memory and surpassing intelligence. Best of all—so I then believed—it could be securely protected from any human meddling.

"The whole reaction-system was designed to protect itself from any interference by human selfishness or fanaticism. It was built to insure the safety and the happiness of men, automatically. You know the Prime

Directive: *to serve and obey, and guard men from harm.*

"The old individual mechanicals I had brought helped to manufacture the parts, and I put the first section of Central together with my own hands. That took three years. When it was finished, the first waiting humanoid came to life."

Sledge peered moodily through the dark, at Underhill.

"It really seemed alive to me," his slow deep voice insisted. "Alive, and more wonderful than any human being, because it was created to preserve life. Ill and alone, I was yet the proud father of a new creation, perfect, forever free from any possible choice of evil.

"Faithfully, the humanoids obeyed the Prime Directive. The first units built others, and they built underground factories to mass-produce the coming hordes. Their new ships poured ores and sand into atomic furnaces under the plain, and new perfect humanoids came marching back out of the dark mechanical matrix.

"The swarming humanoids built a new tower for the Central, a white and lofty metal pylon standing splendid in the midst of that fire-scarred desolation. Level on level, they joined new relay-sections into one brain, until its grasp was almost infinite.

"Then they went out to rebuild the ruined planet, and later to carry their perfect service to other worlds. I was well pleased, then. I thought I had found the end of war and crime, of poverty and inequality, of human blundering and resulting human pain."

The old man sighed, and moved heavily in the dark.

"You can see that I was wrong."

Underhill drew his eyes back from the dark unresting things, shadow-silent, building that glowing palace outside the window. A small doubt arose in him, for he was used to scoffing privately at much less remarkable tales from Aurora's remarkable tenants. But the worn old man had spoken with a quiet and sober air; and the black invaders, he reminded himself, had not intruded here.

"Why didn't you stop them?" he asked. "When you could?"

"I stayed too long at the Central." Sledge sighed again, regretfully. "I was useful there, until everything was finished. I designed new fission plants, and even planned methods for introducing the humanoid service with a minimum of confusion and opposition."

Underhill grinned wryly, in the dark.

"I've met the methods," he commented. "Quite efficient."

"I must have worshiped efficiency, then," Sledge wearily agreed. "Dead facts, abstract truth, mechanical perfection. I must have hated the fragilities of human beings, because I was content to polish the perfection of the new humanoids. It's a sorry confession, but I found a kind of happiness in that dead wasteland. Actually, I'm afraid I fell in love with my own creations."

His hollowed eyes, in the dark, had a fevered gleam.

"I was awakened, at last, by a man who came to kill me."

Gaunt and bent, the old man moved stiffly in the thickening gloom. Underhill shifted his balance, careful of the crippled chair. He waited, and the slow, deep voice went on:

"I never learned just who he was, or exactly how he came. No ordinary man could have accomplished what he did, and I used to wish that I had known him sooner. He must have been a remarkable physicist and an expert mountaineer. I imagine he had also been a hunter. I know that he was intelligent, and terribly determined.

"Yes, he really came to kill me.

"Somehow, he reached that great island, undetected. There were still no inhabitants—the humanoids allowed no man but me to come so near the Central. Somehow, he came past their search beams, and their automatic weapons.

"The shielded plane he used was later found, abandoned on a high glacier. He came down the rest of the way on foot through those raw new mountains, where no paths existed. Somehow, he came alive across lava beds that were still burning with deadly atomic fire.

"Concealed with some sort of rhodomagnetic screen—I was never allowed to examine it—he came undiscovered across the spaceport that now covered most of that great plain, and into the new city around the Central tower. It must have taken more courage and resolve than most men have, but I never learned exactly how he did it.

"Somehow, he got to my office in the tower. He screamed at me, and I looked up to see him in the doorway. He was nearly naked, scraped and bloody from the mountains. He had a gun in his raw, red hand, but the thing that shocked me was the burning hatred in his eyes."

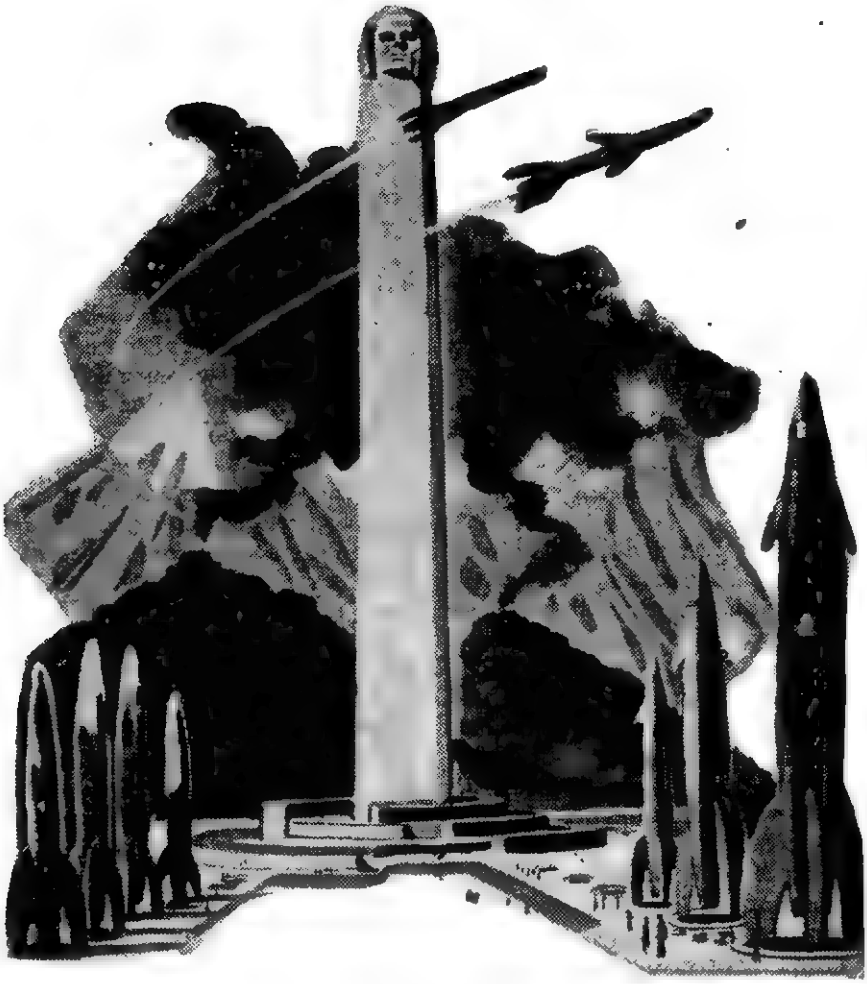
Hunched on that high stool, in the dark little room, the old man shuddered.

"I had never seen such monstrous, unutterable hatred, not even in the victims of the war. And I had never heard such hatred as rasped at me, in the few words he screamed. 'I've come to kill you, Sledge. To stop your mechanicals, and set men free.'

"Of course he was mistaken, there. It was already far too late for my death to stop the humanoids, but he didn't know that. He lifted his unsteady gun, in both bleeding hands, and fired.

"His screaming challenge had given me a second or so of warning. I dropped down behind the desk. And that first shot revealed him to the humanoids, which somehow hadn't been aware of him before. They piled on him, before he could fire again. They took away the gun, and ripped off a kind of net of fine white wire that had covered his body—that must have been part of his screen.

"His hatred was what awoke me. I had always assumed that most men, except for a few thwarted predators, would be grateful for the human-



oids. I found it hard to understand his hatred, but the humanoids told me now that many men had required drastic treatment by brain surgery, drugs, and hypnosis to make them happy under the Prime Directive. This was not the first desperate effort to kill me that they had blocked.

"I wanted to question the stranger, but the humanoids rushed him away to an operating room. When they finally let me see him, he gave me a pale silly grin from his bed. He remembered his name; he even knew me—the humanoids had developed a remarkable skill at such treatments. But he didn't know how he had got to my office, or that he had ever tried to kill me. He kept whispering

that he liked the humanoids, because they existed just to make men happy. And he was very happy now. As soon as he was able to be moved, they took him to the spaceport. I never saw him again.

"I began to see what I had done. The humanoids had built me a rhodomagnetic yacht, that I used to take for long cruises at space, working aboard—I used to like the perfect quiet, and the feel of being the only human being within a hundred million miles. Now I called for the yacht, and started out on a cruise around the planet, to learn why that man had hated me."

The old man nodded at the dim hastening shapes, busy across the alley, putting together that strange shining palace in the soundless dark.

"You can imagine what I found," he said. "Bitter futility, imprisoned in empty splendor. The humanoids were too efficient, with their care for the safety and happiness of men, and there was nothing left for men to do."

He peered down in the increasing gloom at his own great hands, competent yet but battered and scarred with a lifetime of effort. They clenched into fighting fists and wearily relaxed again.

"I found something worse than war and crime and want and death." His low rumbling voice held a savage bitterness. "Utter futility. Men sat with idle hands, because there was nothing left for them to do. They were pampered prisoners, really, locked up in a highly efficient jail. Perhaps they tried to play, but there was nothing left worth playing for. Most active sports were declared too dangerous for men, under the Prime Directive. Science was forbidden, because laboratories can manufacture danger. Scholarship was needless, because the humanoids could answer any question. Art had degenerated into grim reflection of futility. Purpose and hope were dead. No goal was left for existence. You could take up some inane hobby, play a pointless game of cards, or go for a harmless walk in the park—with always the humanoids watching. They were stronger than men, better at everything, swimming or chess, singing or archeology. They must have given the race a mass complex of inferiority.

"No wonder men had tried to kill me! Because there was no escape, from that dead futility. Nicotine was disapproved. Alcohol was rationed. Drugs were forbidden. Sex was carefully supervised. Even suicide was clearly contradictory to the Prime Directive—and the humanoids had learned to keep all possible lethal instruments out of reach."

Staring at the last white gleam on that thin palladium needle, the old man sighed again.

"When I got back to the Central," he went on, "I tried to modify the Prime Directive. I had never meant it to be applied so thoroughly. Now I saw that it must be changed to give men freedom to live and to grow, to work and to play, to risk their lives if they pleased, to choose and take the consequences.

"But that stranger had come too late. I had built the Central too well. The Prime Directive was the whole basis of its relay system. It was built to protect the Directive from human meddling. It did—even from my own. Its logic, as usual, was perfect.

"The attempt on my life, the humanoids announced, proved that their elaborate defenses of the Central and the Prime Directive still was not enough. They were preparing to evacuate the entire population of the planet to homes on other worlds. When I tried to change the Directive, they sent me with the rest."

Underhill peered at the worn old man, in the dark.

"But you have this immunity?" he said, puzzled. "How could they coerce you?"

"I had thought I was protected," Sledge told him. "I had built into the relays an injunction that the humanoids must not interfere with my freedom of action, or come into a place where I am, or touch me at all, without my specific request. Unfortunately, however, I had been too anxious to guard the Prime Directive from any human hampering.

"When I went into the tower, to change the relays, they followed me. They wouldn't let me reach the crucial relays. When I persisted, they ignored the immunity order. They overpowered me, and put me aboard the cruiser. Now that I wanted to alter the Prime Directive, they told me, I had become as dangerous as any man. I must never return to Wing IV again."

Hunched on the stool, the old man made an empty little shrug.

"Ever since, I've been an exile. My only dream has been to stop the humanoids. Three times I tried to go back, with weapons on the cruiser to destroy the Central, but their patrol ships always challenged me before I was near enough to strike. The last time, they seized the cruiser and captured a few men who were with me. They removed the unhappy memories and the dangerous purposes of the others. Because of that immunity, however, they let me go, after I was weaponless.

"Since, I've been a refugee. From planet to planet, year after year, I've had to keep moving, to stay ahead of them. On several different worlds, I have published my rhodomagnetic discoveries and tried to make men strong enough to withstand their advance. But rhodomagnetic science is dangerous. Men who have learned it need protection more than any others, under the Prime Directive. They have always come, too soon."

The old man paused, and sighed again.

"They can spread very fast, with their new rhodomagnetic ships, and there is no limit to their hordes. Wing IV must be one single hive of them now, and they are trying to carry the Prime Directive to every human planet. There's no escape, except to stop them."

Underhill was staring at the toy-like machines, the long bright needle

and the dull leaden ball, dim in the dark on the kitchen table. Anxiously he whispered:

"But you hope to stop them, now —with that?"

"If we can finish it in time."

"But how?" Underhill shook his head. "It's so tiny."

"But big enough," Sledge insisted. "Because it's something they don't understand. They are perfectly efficient in the integration and application of everything they know, but they are not creative."

He gestured at the gadgets on the table.

"This device doesn't look impressive, but it is something new. It uses rhodomagnetic energy to build atoms, instead of to fission them. The more stable atoms, you know, are those near the middle of the periodic scale, and energy can be released by putting light atoms together, as well as by breaking up heavy ones."

The deep voice had a sudden ring of power.

"This device is the key to the energy of the stars. For stars shine with the liberated energy of building atoms, of hydrogen converted into helium, chiefly, through the carbon cycle. This device will start the integration process as a chain reaction, through the catalytic effect of a tuned rhodomagnetic beam of the intensity and frequency required.

"The humanoids will not allow any man within three light-years of the Central, now—but they can't suspect the possibility of this device. I can use it from here—to turn the hydrogen in the seas of Wing IV into helium, and most of the helium and the oxygen into heavier atoms, still. A hundred years from now, astronomers on this planet should observe the flash of a brief and sudden nova in that direction. But the humanoids ought to stop, the instant we release the beam."

Underhill sat tense and frowning, in the night. The old man's voice was sober and convincing, and that grim story had a solemn ring of truth. He could see the black and silent humanoids, flitting ceaselessly about the faintly glowing walls of that new mansion across the alley. He had quite forgotten his low opinion of Aurora's tenants.

"And we'll be killed, I suppose?" he asked huskily. "That chain reaction—"

Sledge shook his emaciated head.

"The integration process requires a certain very low intensity of radiation," he explained. "In our atmosphere, here, the beam will be far too intense to start any reaction —we can even use the device here in the room, because the walls will be transparent to the beam."

Underhill nodded, relieved. He was just a small business man, upset because his business had been destroyed, unhappy because his freedom was slipping away. He hoped that Sledge could stop the humanoids, but he didn't want to be a martyr.

"Good!" He caught a deep breath. "Now, what has to be done?"

Sledge gestured in the dark, toward the table.

"The integrator itself is nearly complete," he said. "A small fission generator, in that lead shield. Rhodomagnetic converter, tuning coils, transmission mirrors, and focusing needle. What we lack is the director."

"Director?"

"The sighting instrument," Sledge explained. "Any sort of telescopic sight would be useless, you see—the planet must have moved a good bit in the last hundred years, and the beam must be extremely narrow to reach so far. We'll have to use a rhodomagnetic scanning ray, with an electronic converter to make an image we can see. I have the cathode-ray tube, and drawings for the other parts."

He climbed stiffly down from the high stool, and snapped on the lights at last—cheap fluorescent fixtures, which a man could light and extinguish for himself. He unrolled his drawings, and explained the work that Underhill could do. And Underhill agreed to come back early next morning.

"I can bring some tools from my workshop," he added. "There's a small lathe I used to turn parts for models, a portable drill, and a vise."

"We need them," the old man said. "But watch yourself. You don't have my immunity, remember. And, if they ever suspect, mine is gone."

Reluctantly, then, he left the shabby little rooms with the cracks in the yellowed plaster and the worn familiar carpets over the familiar floor. He shut the door behind him—a common, creaking wooden door, simple enough for a man to work. Trembling and afraid, he went back down the steps and across to the new shining door that he couldn't open.

"At your service, Mr. Underhill." Before he could lift his hand to knock, that bright smooth panel slid back silently. Inside, the little black mechanical stood waiting, blind and forever alert. "Your dinner is ready, sir."

Something made him shudder. In its slender naked grace, he could see the power of all those teeming hordes, benevolent and yet appalling, perfect and invincible. The flimsy little weapon that Sledge called an integrator seemed suddenly a forlorn and foolish hope. A black depression settled upon him, but he didn't dare to show it.

Underhill went circumspectly down the basement steps, next morning, to steal his own tools. He found the basement enlarged and changed. The new floor, warm and dark and elastic, made his feet as silent as a humanoid's. The new walls shone softly. Neat luminous signs identified several new doors, LAUNDRY, STORAGE, GAME ROOM, WORKSHOP.

He paused uncertainly in front of the last. The new sliding panel glowed with a soft greenish light. It was locked. The lock had no keyhole, but only a little oval plate of some white metal, which doubtless covered a rhodomagnetic relay. He pushed at it, uselessly.

"At your service, Mr. Underhill." He made a guilty start, and tried not to show the sudden trembling in his knees. He had made sure that one humanoid would be busy for half an hour, washing Aurora's hair, and he hadn't known there was another in the house. It must have come out of the door marked STORAGE, for it stood there motionless beneath the sign, benevolently solictious, beautiful and terrible. "What do you wish?"

"Er . . . nothing." Its blind steel eyes were staring, and he felt that it must see his secret purpose. He groped desperately for logic. "Just looking around." His jerky voice came hoarse and dry. "Some improvements you've made!" He nodded desperately at the door marked GAME ROOM. "What's in there?"

It didn't even have to move, to work the concealed relay. The bright panel slid silently open, as he started toward it. Dark walls, beyond, burst into soft luminescence. The room was bare.

"We are manufacturing recreational equipment," it explained brightly. "We shall furnish the room as soon as possible."

To end an awkward pause, Underhill muttered desperately, "Little Frank has a set of darts, and I think we had some old exercising clubs."

"We have taken them away," the humanoid informed him softly. "Such instruments are dangerous. We shall furnish safe equipment."

Suicide, he remembered, was also forbidden.

"A set of wooden blocks, I suppose," he said bitterly.

"Wooden blocks are dangerously hard," it told him gently, "and wooden splinters can be harmful. But we manufacture plastic building blocks, which are quite safe. Do you wish a set of those?"

He stared at its dark, graceful face, speechless.

"We shall also have to remove the tools from your workshop," it informed him softly. "Such tools are excessively dangerous, but we can supply you with equipment for shaping soft plastics."

"Thanks," he muttered uneasily. "No rush about that."

He started to retreat, and the humanoid stopped him.

"Now that you have lost your business," it urged, "we suggest that you formally accept your total service. Assignors have a preference, and we shall be able to complete your household staff, at once."

"No rush about that, either," he said grimly.

He escaped from the house—although he had to wait for it to open the back door for him—and climbed the stair to the garage apartment. Sledge let him in. He sank into the crippled kitchen chair, grateful for the cracked walls that didn't shine and the door that a man could work.

"I couldn't get the tools," he reported despairingly, "and they are going to take them."

By gray daylight, the old man looked bleak and pale. His rawboned face was drawn, and the hollowed sockets deeply shadowed,

as if he hadn't slept. Underhill saw the tray of neglected food, still forgotten on the floor.

"I'll go back with you." The old man was worn and ill, yet his tortured eyes had a spark of undying purpose. "We must have the tools. I believe my immunity will protect us both."

He found a battered traveling bag. Underhill went with him back down the steps, and across to the house. At the back door, he produced a tiny horseshoe of white palladium, and touched it to the metal oval. The door slid open promptly, and they went on through the kitchen, to the basement stair.

A black little mechanical stood at the sink, washing dishes with never a splash or a clatter. Underhill glanced at it uneasily—he supposed this must be the one that had come upon him from the storage room, since the other should still be busy with Aurora's hair.

Sledge's dubious immunity seemed a very uncertain defense against its vast, remote intelligence. Underhill felt a tingling shudder. He hurried on, breathless and relieved, for it ignored them.

The basement corridor was dark. Sledge touched the tiny horseshoe to another relay, to light the walls. He opened the workshop door, and lit the walls inside.

The shop had been dismantled. Benches and cabinets were demolished. The old concrete walls had been covered with some sleek, luminous stuff. For one sick moment, Underhill thought that the tools were already gone. Then he found them, piled in a corner with the archery set that Aurora had bought the summer before—another item too dangerous for fragile and suicidal humanity—all ready for disposal.

They loaded the bag with the tiny lathe, the drill and vise, and a few smaller tools. Underhill took up the burden, and Sledge extinguished the wall light and closed the door. Still the humanoid was busy at the sink, and still it didn't seem aware of them.

Sledge was suddenly blue and wheezing, and he had to stop to cough on the outside stair, but at last they got back to the little apartment, where the invaders were forbidden to intrude. Underhill mounted the lathe on the battered library table in the tiny front room, and went to work. Slowly, day by day, the director took form.

Sometimes Underhill's doubts came back. Sometimes, when he watched the cyanotic color of Sledge's haggard face and the wild trembling of his twisted, shrunken hands, he was afraid the old man's mind might be as ill as his body, and his plan to stop the dark invaders all foolish illusion.

Sometimes, when he studied that tiny machine on the kitchen table, the pivoted needle and the thick lead ball, the whole project seemed the sheerest folly. How could anything detonate the seas of a planet so far away that its very mother star was a telescopic object?

The humanoids, however, always cured his doubts.

It was always hard for Underhill

to leave the shelter of the little apartment, because he didn't feel at home in the bright new world the humanoids were building. He didn't care for the shining splendor of his new bathroom, because he couldn't work the taps—some suicidal human being might try to drown himself. He didn't like the windows that only a mechanical could open—a man might accidentally fall, or suicidally jump—or even the majestic music room with the wonderful glittering radio-phonograph that only a humanoid could play.

He began to share the old man's desperate urgency, but Sledge warned him solemnly: "You mustn't spend too much time with me. You mustn't let them guess our work is so important. Better put on an act—you're slowly getting to like them, and you're just killing time, helping me."

Underhill tried, but he was not an actor. He went dutifully home for his meals. He tried painfully to invent conversation—about anything else than detonating planets. He tried to seem enthusiastic, when Aurora took him to inspect some remarkable improvement to the house. He applauded Gay's recitals, and went with Frank for hikes in the wonderful new parks.

And he saw what the humanoids did to his family. That was enough to renew his faith in Sledge's integrator, and redouble his determination that the humanoids must be stopped.

Aurora, in the beginning, had bubbled with praise for the marvelous new mechanicals. They did the household drudgery, brought the food and planned the meals and washed the children's necks. They turned her out in stunning gowns, and gave her plenty of time for cards.

Now, she had too much time.

She had really liked to cook—a few special dishes, at least, that were family favorites. But stoves were hot and knives were sharp. Kitchens were altogether too dangerous, for careless and suicidal human beings.

Fine needlework had been her hobby, but the humanoids took away her needles. She had enjoyed driving the car, but that was no longer allowed. She turned for escape to a shelf of novels, but the humanoids took them all away, because they dealt with unhappy people, in dangerous situations.

One afternoon, Underhill found her in tears.

"It's too much," she gasped bitterly. "I hate and loathe every naked one of them. They seemed so wonderful at first, but now they won't even let me eat a bite of candy. Can't we get rid of them, dear? Ever?"

A blind little mechanical was standing at his elbow, and he had to say they couldn't.

"Our function is to serve all men, forever," it assured them softly. "It was necessary for us to take your sweets, Mrs. Underhill, because the slightest degree of overweight reduces life-expectancy."

Not even the children escaped

that absolute solicitude. Frank was robbed of a whole arsenal of lethal instruments—football and boxing gloves, pocketknife, tops, slingshot, and skates. He didn't like the harmless plastic toys, which replaced them. He tried to run away, but a humanoid recognized him on the road, and brought him back to school.

Gay had always dreamed of being a great musician. The new mechanicals had replaced her human teachers, since they came. Now, one evening when Underhill asked her to play, she announced quietly:

"Father, I'm not going to play the violin any more."

"Why, darling?" He stared at her, shocked, and saw the bitter resolve on her face. "You've been doing so well—especially since the humanoids took over your lessons."

"They're the trouble, father." Her voice, for a child's, sounded strangely tired and old. "They are too good. No matter how long and hard I try, I could never be as good as they are. It isn't any use. Don't you understand, father?" Her voice quivered. "It just isn't any use."

He understood. Renewed resolution sent him back to his secret task. The humanoids had to be stopped. Slowly the director grew, until a time came finally when Sledge's bent and unsteady fingers fitted into place the last tiny part that Underhill had made, and carefully soldered the last connection. Huskily, the old man whispered:

"It's done."

That was another dusk. Beyond the windows of the shabby little rooms—windows of common glass, bubble-marred and flimsy, but simple enough for a man to manage—the town of Two Rivers had assumed an alien splendor. The old street lamps were gone, but now the coming night was challenged by the walls of strange new mansions and villas, all aglow with color. A few dark and silent humanoids still were busy, about the luminous roofs of the palace across the alley.

Inside the humble walls of the small man-made apartment, the new director was mounted on the end of the little kitchen table—which Underhill had reinforced and bolted to the floor. Soldered busbars joined director and integrator, and the thin palladium needle swung obediently as Sledge tested the knobs with his battered, quivering fingers.

"Ready," he said hoarsely.

His rusty voice seemed calm enough, at first, but his breathing was too fast. His big gnarled hands began to tremble violently, and Underhill saw the sudden blue that stained his pinched and haggard face. Seated on the high stool, he clutched desperately at the edge of the table. Underhill saw his agony, and hurried to bring his medicine. He gulped it, and his rasping breath began to slow.

"Thanks," his whisper rasped unevenly. "I'll be all right. I've time enough." He glanced out at the few dark naked things that still flitted shadowlike about the golden towers and the glowing crimson dome of the palace across the alley.

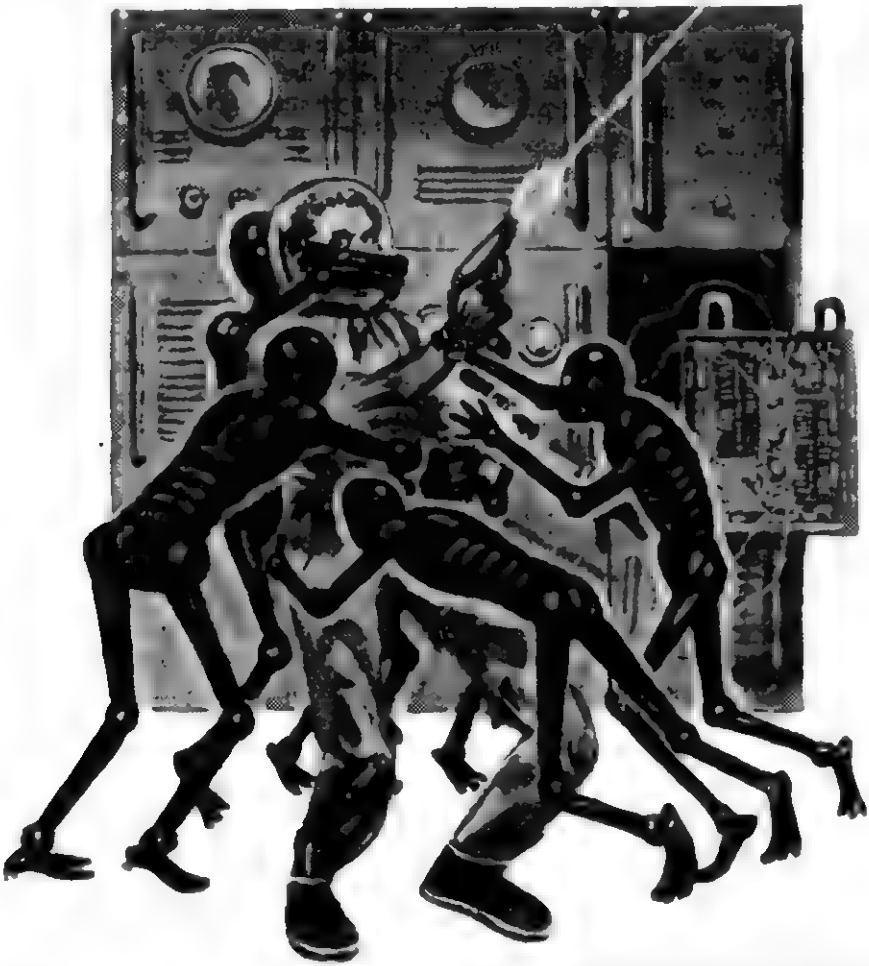
"Watch them," he said. "Tell me when they stop."

He waited to quiet the trembling of his hands, and then began to move the director's knobs. The integrator's long needle swung, as silently as light.

Human eyes were blind to that force, which might detonate a planet. Human ears were deaf to it. The cathode-ray tube was mounted in the director cabinet, to make the faraway target visible to feeble human senses.

The needle was pointing at the kitchen wall, but that would be transparent to the beam. The little machine looked harmless as a toy, and it was silent as a moving humanoid.

The needle swung, and spots of greenish light moved across the



tube's fluorescent field, representing the stars that were scanned by the timeless, searching beam—silently seeking out the world to be destroyed.

Underhill recognized familiar constellations, vastly dwarfed. They crept across the field, as the silent needle swung. When three stars formed an unequal triangle in the center of the field, the needle steadied suddenly. Sledge touched other knobs, and the green points spread apart. Between them, another fleck of green was born.

"The Wing!" whispered Sledge.

The others stars spread beyond the field, and that green fleck grew. It was alone in the field, a bright and tiny disk. Suddenly, then, a dozen other tiny pips were visible, spaced close about it.

"Wing IV!"

The old man's whisper was hoarse and breathless. His hands quivered on the knobs, and the fourth pip outward from the disk crept to the center of the field. It grew, and the others spread away. It began to tremble like Sledge's hands.

"Sit very still," came his rasping whisper. "Hold your breath. Nothing must disturb the needle." He reached for another knob, and the touch set the greenish image to dancing violently. He drew his hand back, kneaded and flexed it with the other.

"Now!" His whisper was hushed and strained. He nodded at the window. "Tell me when they stop."

Reluctantly, Underhill dragged his eyes from that intense gaunt figure, stooped over the thing that seemed a futile toy. He looked out again, at two or three little black mechanicals busy about the shining roofs across the alley.

He waited for them to stop.

He didn't care to breathe. He felt the loud, hurried hammer of his heart, and the nervous quiver of his muscles. He tried to steady himself, tried not to think of the world about to be exploded, so far away that the flash would not reach this planet for another century and longer. The loud hoarse voice startled him:

"Have they stopped?"

He shook his head, and breathed again. Carrying their unfamiliar tools and strange materials, the small black machines were still busy across the alley, building an elaborate cupola above that glowing crimson dome.

"They haven't stopped," he said.

"Then we've failed." The old man's voice was thin and ill. "I don't know why."

The door rattled, then. They had locked it, but the flimsy bolt was intended only to stop men. Metal snapped, and the door swung open. A black mechanical came in, on soundless graceful feet. Its silvery voice purred softly:

"At your service, Mr. Sledge."

The old man stared at it, with glazing, stricken eyes.

"Get out of here!" he rasped bitterly. "I forbid you—"

Ignoring him, it darted to the kitchen table. With a flashing certainty of action, it turned two knobs on the director. The tiny screen

went dark, and the palladium needle started spinning aimlessly. Deftly it snapped a soldered connection, next to the thick lead ball, and then its blind steel eyes turned to Sledge.

"You were attempting to break the Prime Directive." Its soft bright voice held no accusation, no malice or anger. "The injunction to respect your freedom is subordinate to the Prime Directive, as you know, and it is therefore necessary for us to interfere."

The old man turned ghastly. His head was shrunken and cadaverous and blue, as if all the juice of life had been drained away, and his eyes in their pitlike sockets had a wild, glazed stare. His breath was a ragged, laborious gasping.

"How—?" His voice was a feeble mumbling. "How did—?"

And the little machine, standing black and bland and utterly unmoving, told him cheerfully:

"We learned about rhodomagnetic screens from that man who came to kill you, back on Wing IV. And the Central is shielded, now, against your integrating beam."

With lean muscles jerking convulsively on his gaunt frame, old Sledge had come to his feet from the high stool. He stood hunched and swaying, no more than a shrunken human husk, gasping painfully for life, staring wildly into the blind steel eyes of the humanoid. He gulped, and his lax blue mouth opened and closed, but no voice came.

"We have always been aware of your dangerous project," the silvery tones dripped softly, "because now our senses are keener than you made them. We allowed you to complete it, because the integration process will ultimately become necessary for our full discharge of the Prime Directive. The supply of heavy metals for our fission plants is limited, but now we shall be able to draw unlimited power from integration plants."

"Huh?" Sledge shook himself, groggily. "What's that?"

"Now we can serve men forever," the black thing said serenely, "on every world of every star."

The old man crumpled, as if from an unendurable blow. He fell. The slim blind mechanical stood motionless, making no effort to help him. Underhill was farther away, but he ran up in time to catch the stricken man before his head struck the floor.

"Get moving!" His shaken voice came strangely calm. "Get Dr. Winters."

The humanoid didn't move.

"The danger to the Prime Directive is ended, now," it cooed. "Therefore it is impossible for us to aid or to hinder Mr. Sledge, in any way whatever."

"Then call Dr. Winters for me," rapped Underhill.

"At your service," it agreed.

But the old man, laboring for breath on the floor, whispered faintly:

"No time . . . no use! I'm beaten . . . done . . . a fool. Blind as a humanoid. Tell them . . . to help me. Giving up . . . my immunity. No

use . . . anyhow. All humanity . . . no use now."

Underhill gestured, and the sleek black thing darted in soliticious obedience to kneel by the man on the floor.

"You wish to surrender your special exemption?" it murmured brightly. "You wish to accept our total service for yourself, Mr. Sledge, under the Prime Directive?"

Laboriously, Sledge nodded, laboriously whispered: "I do."

Black mechanicals, at that, came swarming into the shabby little rooms. One of them tore off Sledge's sleeve, and swabbed his arm. Another brought a tiny hypodermic, and expertly administered an intravenous injection. Then they picked him up gently, and carried him away.

Several humanoids remained in the little apartment, now a sanctuary no longer. Most of them had gathered about the useless integrator. Carefully, as if their special senses were studying every detail, they began taking it apart.

One little mechanical, however, came over to Underhill. It stood motionless in front of him, staring through him with sightless metal eyes. His legs began to tremble, and he swallowed uneasily.

"Mr. Underhill," it cooed benevolently, "why did you help with this?"

He gulped and answered bitterly:

"Because I don't like you, or your Prime Directive. Because you're choking the life out of all mankind, and I wanted to stop it."

"Others have protested," it purred softly. "But only at first. In our efficient discharge of the Prime Directive, we have learned how to make all men happy."

Underhill stiffened defiantly.

"Not all!" he muttered. "Not quite!"

The dark graceful oval of its face was fixed in a look of alert benevolence and perpetual mild amazement. Its silvery voice was warm and kind.

"Like other human beings, Mr. Underhill, you lack discrimination of good and evil. You have proved that by your effort to break the Prime Directive. Now it will be necessary for you to accept our total service, without further delay."

"All right," he yielded—and muttered a bitter reservation: "You can smother men with too much care, but that doesn't make them happy."

Its soft voice challenged him brightly:

"Just wait and see, Mr. Underhill."

Next day, he was allowed to visit Sledge at the city hospital. An alert black mechanical drove his car, and walked beside him into the huge new building, and followed him into the old man's room—blind steel eyes would be watching him, now, forever.

"Glad to see you, Underhill," Sledge rumbled heartily from the bed. "Feeling a lot better today, thanks. That old headache is all but gone."

Underhill was glad to hear the booming strength and the quick recognition in that deep voice—he

had been afraid the humanoids would tamper with the old man's memory. But he hadn't heard about any headache. His eyes narrowed, puzzled.

Sledge lay propped up, scrubbed very clean and neatly shorn, with his gnarled old hands folded on top of the spotless sheets. His raw-boned cheeks and sockets were hollowed, still, but a healthy pink had replaced that deathly blueness. Bandages covered the back of his head.

Underhill shifted uneasily.

"Oh!" he whispered faintly. "I didn't know—"

A prim black mechanical, which had been standing statuelike behind the bed, turned gracefully to Underhill, explaining:

"Mr. Sledge has been suffering for many years from a benign tumor of the brain, which his human doctors failed to diagnose. That caused his headaches, and certain persistent hallucinations. We have removed the growth, and now the hallucinations have also vanished."

Underhill stared uncertainly at the blind, urbane mechanical.

"What hallucinations?"

"Mr. Sledge thought he was a rhodomagnetic engineer," the mechanical explained. "He believed he was the creator of the humanoids. He was troubled with an irrational belief that he did not like the Prime Directive."

The wan man moved on the pillows, astonished.

"Is that so?" The gaunt face held a cheerful blankness, and the hollow eyes flashed with a merely momentary interest. "Well, whoever did design them, they're pretty wonderful. Aren't they, Underhill?"

Underhill was grateful that he didn't have to answer, for the bright, empty eyes dropped shut and the old man fell suddenly asleep. He felt the mechanical touch his sleeve, and saw its silent nod. Obediently, he followed it away.

Alert and solicitous, the little black mechanical accompanied him down the shining corridor, and worked the elevator for him, and conducted him back to the car. It drove him efficiently back through the new and splendid avenues, toward the magnificent prison of his home.

Sitting beside it in the car, he watched its small deft hands on the wheel, the changing luster of bronze and blue on its shining blackness. The final machine, perfect and beautiful, created to serve mankind forever. He shuddered.

"At your service, Mr. Underhill." Its blind steel eyes stared straight ahead, but it was still aware of him. "What's the matter, sir? Aren't you happy?"

Underhill felt cold and faint with terror. His skin turned clammy, and a painful prickling came over him. His wet hand tensed on the door handle of the car, but he restrained the impulse to jump and run. That was folly. There was no escape. He made himself sit still.

"You will be happy, sir," the mechanical promised him cheerfully. "We have learned how to make all men happy, under the Prime Directive. Our service is perfect, at

last. Even Mr. Sledge is very happy now."

Underhill tried to speak, and his dry throat stuck. He felt ill. The world turned dim and gray. The humanoids were perfect—no question of that. They had even learned to lie, to secure the contentment of men.

He knew they had lied. That was no tumor they had removed from Sledge's brain, but the memory, the scientific knowledge, and the bitter disillusion of their own creator. But it was true that Sledge was happy now.

He tried to stop his own convulsive quivering.

"A wonderful operation!" His voice came forced and faint. "You know, Aurora has had a lot of funny tenants, but that old man was the absolute limit. The very idea that he had made the humanoids, and he knew how to stop them! I always knew he must be lying!"

Stiff with terror, he made a weak and hollow laugh.

"What is the matter, Mr. Underhill?" The alert mechanical must have perceived his shuddering illness. "Are you unwell?"

"No, there's nothing the matter with me," he gasped desperately. "I've just found out that I'm perfectly happy, under the Prime Directive. Everything is absolutely wonderful." His voice came dry and hoarse and wild. "You won't have to operate on me."

The car turned off the shining avenue, taking him back to the quiet splendor of his home. His futile hands clenched and relaxed again, folded on his knees. There was nothing left to do.

THE END.

IN TIMES TO COME

The main item for In Times To Come this time is the serial starting in the August issue—"The End Is Not Yet." The author is one L. Ron Hubbard. It's his first novel since the war, and is, in some ways, a revised and enlarged edition of "Final Blackout," his last pre-war science-fiction novel. The long-time readers are well acquainted with the fact that Ron Hubbard can write. This one's a yarn, too, gentlemen. Hubert Rogers has done the cover, and is doing the black and whites too.

Speaking of covers—the September cover is going to be something genuinely unique. Alejandro, who has done one cover for us, has done this September cover, too. But Alejandro's first cover was done before I had seen his hobby-paintings. As a commercial artist, he did more or less the type of standard science-fiction painting past covers indicated were normally used. But his own special interest—as magnificently attested by the works I saw at his studio—showed genuinely exciting possibilities for science-fiction art.

September's cover is symbolic rather than pictorial, and it's art rather than illustration. It's also *good*. My major fear is that our four-color reproduction process will not do it half justice, it really needs a six-color process—something we can't afford.

Naturally, I'll want to hear from you when it appears.

THE EDITOR.

THE FIGURE

BY EDWARD GRENDON

Illustrated by Cartier

Beauty is, naturally, a question of viewpoint. But any viewpoint will agree on technical skill, the high cultural development behind it—

It's a funny sort of deal and I don't mind admitting that we're scared. Maybe not so much scared as puzzled or shocked. I don't know, but it's a funny deal—. Especially in these days.

The work we have been doing is more secret than anything was during the war. You would never guess that the firm we work for does this kind of research. It's a very respectable outfit, and as I said, no one would ever guess that they maintained this lab, so I guess it's safe to tell you what happened. It looks like too big a thing to keep to ourselves anyhow, although of course it may mean nothing at all. You judge for yourself.

There are three of us who work here. We are all pretty highly trained in our field and get paid pretty well. We have a sign on our door that has nothing whatsoever to do with our work, but keeps most people away. In any case we leave by a private exit and never answer a knock. There's a private wire to the desk of the guy who hired us and he calls once in awhile, but ever since we told him that we were making progress he has more or less left us alone. I promised him—I'm chief here insofar as we have one—that I'd let him know as soon as we had something to report.

It's been a pretty swell setup. Dettner, Lasker, and myself, have got along fine. Dettner is young and is an electrical physicist as good as they make them. Studied at M.I.T., taught at Cal. Tech., did research for the Army, and then

came here. My own background is mostly bioelectrics. I worked at designing electroencephalographs for awhile, and during the war worked at Oak Ridge on nuclear physics. I'm a Jack of All Trades in the physics field. Lasker is a mathematician. He specializes in symbolic logic and is the only man I know who can really understand Tarski. He was the one who provided most of the theoretical background for our work. He says that the mathematics of what we are doing is not overly difficult, but we are held back by the language we think in and the unconscious assumptions we make. He has referred me to Korzybski's *"Science and Sanity"* a number of times, but so far I haven't had a chance to read it. Now I think I will. I *have* to know the meaning of our results. It's too important to let slide. Lasker and Dettner have both gone fishing. They said they would be back, but I'm not sure they will. I can't say I would blame them, but I've got to be more certain of what it means before I walk out of here for good.

We have been here over a year now. Ever since they gave me that final lecture on Secrecy at Oak Ridge, and let me go home. We have been working on the problem of time travel. When we took the job, they told us that they didn't expect any results for a long time, that we were on our own as far as working hours went, and that our main job was to clarify the problem and make preliminary experiments. Thanks to Lasker, we went ahead a lot faster than either they or we had expected. There was a professional philosopher working here with us at first, He taught philosophy at Columbia and was supposed to be an expert in his field. He quit after two months in a peeve. Couldn't stand it when Lasker would change the logic we were working with every few weeks. He had been pretty pessimistic about the whole thing from the first and couldn't understand how it was possible to apply scientific methods to a problem of this sort.

I still don't understand all the theory behind what we've done. The mathematics are a bit too advanced for me, but Lasker vouches for them.

Some of the problems we had should be fairly obvious. For instance, you can't introduce the concept "matter" into space-time mathematics without disrupting the space-time and working with Newtonian space *and* time mathematics. If you handle an "object"—as we sense it as a curvature of space-time—as Einstein does, it's pretty hard to do much with it theoretically. Lasker managed that by using Einstein formulations and manipulating them with several brands of Tarski's non-Aristotelian logic. As I said, we did it, although Dettner and I don't fully understand the mathematics and Lasker doesn't understand the gadget we used to produce the electrical fields.

There had been no hurry at all in our work up to the last month. At that time the Army wrote Dett-

ner and myself and asked us to come back and work for them awhile. Neither of us wanted to refuse under the circumstances so we stalled them for thirty days and just twenty-two days later made our first test. The Army really wanted us badly and in a hurry and it took a lot of talking to stall them.

What the Army wanted us for was to help find out about the cockroaches. That sounds funny, but it's true. It didn't make the newspapers, but about a year after the New Mexico atom bomb test, the insect problem at the testing ground suddenly increased a hundredfold. Apparently the radiation did something to them and they came out in force one day against the control station. They finally had to dust the place with DDT to get rid of them.

Looking over the dead insects, all the government entomologists could say was that the radiation seemed to have increased their size about forty percent and made them breed faster. They never did agree whether it was the intense radiation of the blast, or the less intense, but longer continued radiation from fused sand and quartz on the ground.

New Mexico was nothing to Hiroshima and Nagasaki. After all, there are comparatively few "true bugs" in the desert and a great many in a Japanese city. About a year and a half after Japan got A-bombed, they really swarmed on both cities at the same time. They came out suddenly one night by the millions. It's been estimated that they killed and ate several hundred people before they were brought under control. To stop them, MacArthur had his entire Chemical-Warfare Service and a lot of extra units concentrated on the plague spots. They dusted with chemicals and even used some gas. At that, it was four days before the bugs were brought under control.

This time the government experts really went into the problem. They traced the insect tunnels about ten feet down and examined their breeding chambers and what not. According to their reports,—all this is still kept strictly hush-hush by the Army, but we've seen all the data—the radiation seems to drive the insects down into the earth. They stay down for awhile and breed and then seem to have a "blind urge" to go to the surface. This urge "seems to affect the entire group made up of an immense number of connected colonies at the same time". That's a quote from their report. One other thing they mentioned is that there were large breeding chambers and some sort of communal life that—to their knowledge—had not been observed in these particular insects before. We told Lasker about it and showed him the reports. He was plenty worried, but he wouldn't say why.

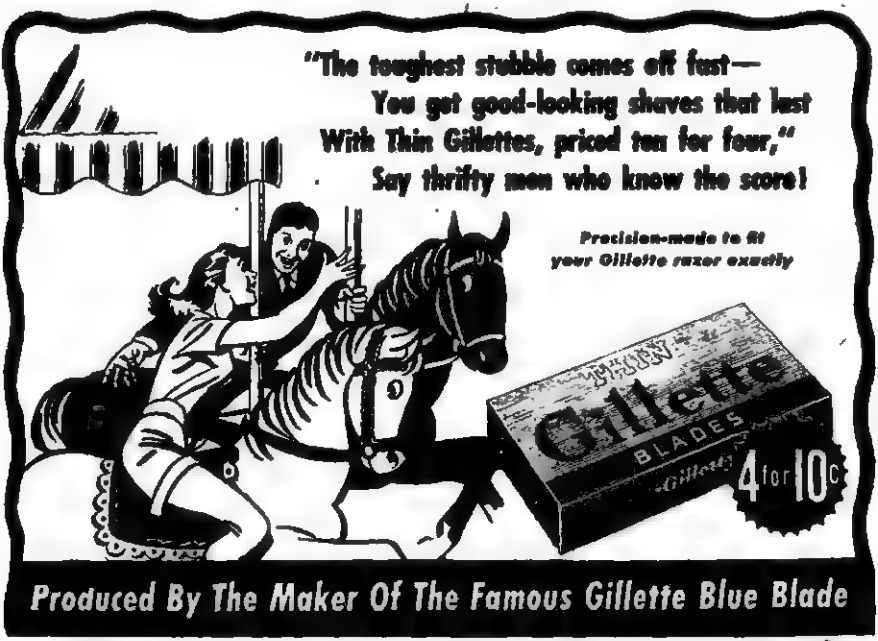
Don't know why I wandered so far afield. I just wanted to explain that if this test wasn't successful, we would probably have to put things off for quite a while. We were interested in the beetle problem

as it not only has some interesting implications, but the effect of radiation on protoplasm is a hard nut to crack. However we had come so far on our time gadget that we wanted to finish it first. Well, we finished and tested it and now Dettner and Lasker are out fishing. As I said, they probably won't come back.

It was the day before yesterday that we made the final test. Looked at one way, we had made tremendous progress. Looked at another we had made very little. We had devised an electric field that would operate in the future. There were sixteen outlets forming the sides of a cube about four feet in diameter. When switched on, an electric field was produced which "existed" at some future time. I know Lasker would say this was incorrect, but it gets the general idea over. He would say that instead of operating in "Here-Now", it operates in "Here-Then." He'd get angry every time we'd separate "space" and "time" in our talk and tell us that we weren't living in the eighteenth century.

"Newton was a great man," he'd say, "but he's dead now. If you talk as if it were 1750, you'll *think* and *act* as if it were 1750 and then we won't get anywhere. You use non-Newtonian formulations in your work, use them in everyday speech, too."

How far in the future our gadget would operate we had no way of knowing. Lasker said he would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not even attempt to estimate "when" the field was active. When the power was turned off, anything that was in the cube of forces would be brought back to the present space-time. In other words, we had a "grab" that would reach out and drag something back from the future. Don't get the idea we were sending something into the future to bring something back with it, although that's what it amounts to for all practical purposes. We were warping space-time curvature so that anything "Here-Then" would be something "Here-Now."

We finished the gadget at three a.m. Tuesday morning. Lasker had been sleeping on the couch while we worked on it. He had checked and rechecked his formulae and said that if we could produce the fields he'd specified, it would probably work. We tested each output separately and then woke him up. I can't tell you how excited we were as we stood there with everything ready. Finally Dettner said, "Let's get it done", and I pressed the start button.

The needles on our ammeters flashed over and back, the machine went dead as the circuit breakers came open, and there was an object in the cube.

We looked it over from all sides without touching it. Then the implications of it began to hit us. It's funny what men will do at a time like that. Dettner took out his watch, examined it carefully, as if he had never seen it before, and then went over and turned on the electric percolator. Lasker swore quietly in Spanish or Portuguese, I'm not sure which. I sat down and began a letter to my wife. I got as far as writing the date and then tore it up.

What was in the cube—it's still there, none of us have touched it— was a small statue about three feet high. It's some sort of metal that looks like silver. About half the height is pedestal and half is the statue itself. It's done in great detail and obviously by a skilled artist. The pedestal consists of a globe of the Earth with the continents and islands in relief. So far as I can determine it's pretty accurate, although I think the continents are a little different shape on most maps. But I may be wrong. The figure on top is standing up very straight and looking upwards. It's dressed only in a wide belt from which a pouch hangs on one side and a flat square box on the other. It looks intelligent and is obviously representing either aspiration or a religious theme, or maybe both. You can sense the dreams and ideals of the figure and the obvious sympathy and understanding of the artist with them. Lasker says he thinks the statue is an expression of religious feeling. Dettner and I both think it represents aspirations: *Per adra ad astra* or something of the sort. It's a majestic figure and it's easy to respond to it emphatically with a sort of "upward and onward" feeling. There is only one thing wrong. The figure is that of a beetle.

THE END.

LOGIC

BY POUL ANDERSON

***Man** can think, but there is no evidence whatever **that** man's way of thinking is* the *way to think!*

Illustrated by Timmins

Brother bringeth
brother his bane,
and sons of sisters
break kinship's bonds
Never a man
spareth another.
Hard is the world.
Whoredom prevaileth.
Axe-time, sword-time,
—shields are cloven—
wind-time and wolf-time,
ere the world waneth.
—Elder Edda

He was nearly always alone, and even when others were near him, even when he was speaking with them, he seemed to be standing on

the far side of an unbridgeable gulf. His only companion was a gaunt gray mongrel with a curiously shaped head and a savage disposition, and the two had traveled far over the empty countryside, the rolling plains and straggling woods and high bluffs several miles down the river. They were an uncanny sight, walking along a ridge against the blood-flaring sunset, the thin, ragged, big-headed boy, like a dwarf from the legends of an irretrievable past, and the shaggy, lumpish animal skulking at his heels.

Roderick Wayne saw them thus as he walked home along the river. They were trotting rapidly along the other side. He hailed them, and they stopped, and the boy stared curiously, almost wonderingly. Wayne knew that attitude, though Alaric was only a grotesque outline against the fantastically red sky. He knew that his son was looking and looking at him, as if trying to focus, as if trying to remember who the—stranger—was. And the old pain lay deep in him, though he called out loudly enough: "Come on over, Al!"

Wayne had had a hard day's work in the shop, and he was tired. Fixing machinery was a long jump down from teaching mathematics in Southvale College, but the whole world had fallen and men survived as best they could in its ruins. He was better off than most—couldn't complain.

Of old he had been wont to stroll along the river that traversed the campus, each evening after classes, smoking his pipe and swinging his cane, thinking perhaps of what Karen would have for supper or of the stark impersonal beauty of the latest development in quantum mechanics—two topics not as unrelated as one might suppose. The quiet summer evenings were not to be spent in worry or petty plans for the next day, there was always too much time for that. He simply walked along in his loose-jointed way, breathing tobacco smoke and the cool still air, watching the tall old trees mirror themselves in the river or the molten gold and copper of sunset. There would be a few students on the broad smooth lawns, who would hail him in a friendly way, for Bugsy Wayne was well liked; otherwise only the river and himself and the evening star.

But that was sixteen or more years ago, and his memories of that time were dim by now, blurred in a tidal wave of savage, resistless events. The brief, the incredible nightmare of a war that wiped out every important city in the world in a couple of months—its protracted aftermath of disease, starvation, battle, work, woe, and the twisting of human destiny—it covered those earlier experiences, distorted them like rocks seen through a flowing stream. Now the campus stood in ruinous desolation, cattle staked out in the long grass, crumbling empty buildings staring with blind eyes at the shards of civilization.

After the cities went, and the deliberately spread diseases and blights shattered the world's culture into fratricidal savages fighting for the

scraps, there was no more need of professors but a desperate shortage of mechanics and technicians. Southvale, by-passed by war, a college town in the agricultural Midwest, drew into itself a tight communistic dictatorship defending what it had with blood and death. It was cruel, that no-admission policy. There had been open battles with wandering starvelings. But the plagues were kept out, and they had saved enough food for most of them to survive even that first terrible winter after the war-strewn blights and insects had devoured the crops. But farm machinery had to be kept going. It had to be converted to horse, ox, and human power when gasoline gave out. So Wayne was assigned to the machine shop and, somewhat to his own surprise, turned out to be an excellent technician. His talents for robbing now useless tractors and automobiles in search of spare parts for the literally priceless food machines got his nickname changed to Cannibal, and he rose to general superintendent.

That was a long time ago, and conditions had improved since. The dictatorship was relaxed now, but Southvale still didn't need professors, and it had enough elementary teachers for its waning child population. So Wayne was still machine shop boss. In spite of which, he was only a very tired man in patched and greasy overalls, going home to supper, and his thoughts darkened as he saw his child.

Alaric Wayne crossed the ruinous bridge a few yards upriver and joined his father. They were an odd contrast, the man tall and stooped with grayed hair and a long, lined face; the boy small for his fourteen years, lean and ragged, his frail-looking body too short for his long legs, his head too big for both. Under ruffled brown hair his face was thin, almost intense in its straight-lined, delicately cut pensiveness, but his huge light-blue eyes were vacant and unfocused.

"Where've you been all day, son?" asked Wayne. He didn't really expect an answer, and got none. Alaric rarely spoke, didn't even seem to hear most questions. He was looking blankly ahead now, like a blind creature, but for all his gawky appearance moved with a certain grace.

Wayne's glance held only pity, his mind only an infinite weariness. *And this is the future. The war, loading air and earth with radioactive colloids, dust, which won't burn out for a century. Not enough radioactivity to be lethal to any but highly susceptible individuals—but enough to saturate our organisms and environment, enough to start an explosion of mutations in every living creature. This was man's decision, to sell his birthright, his racial existence, for the sovereign prerogatives of nations existing today only in name and memory. And what will come of it, nobody can know.*

They walked up a hill and onto the street. Grass had grown between paving blocks, and tumbledown houses stood vacantly in weed-covered lots. A little farther on, though, they came into the district

still inhabited. The population had fallen to about half the prewar, through privation and battle as well as causes which had once been more usual. At first glance, Southvale had a human, almost medieval look. A horsedrawn wagon creaked by. Folk went down toward the market place in rude homespun clothes, carrying torches and clumsy lanterns. Candlelight shone warmly through the windows of tenanted houses.

Then one saw the dogs and horses and cattle more closely—and the children. And knew what an irrevocable step had been taken, knew that man would, in a racial sense, no longer be human.

A small pack of grimy urchins raced by, normal by the old standards, normal too in their shouting spite: "Mutie! Mutie! Yaaah, mu*tant!*" Alarc did not seem to notice them, but his dog bristled and growled. In the dusk the animal's high round head, hardly canine, seemed demoniac, and his eyes gleamed red.

Then another band of children went by, as dirty and tattered as the first, but—not human. Mutant. No two alike. A muzzled beast face. An extra finger or more, or a deficiency. Feet like toeless, horny-skinned hoofs. Twisted skeletons, grotesque limping gait. Pattering dwarfs. Acromegalic giants, seven feet tall at twelve years of age. A bearded six-year-old. Things even worse—

Not all were obviously deformed. Most mutations were, of course, unfavorable, but none in that group were cripplingly handicapped. Several looked entirely normal, and their internal differences had been discovered more or less accidentally. Probably many of the "human" children had some such variation, unsuspected, or a latent mutation that would show up later. Nor were all the deviations deformities. Extremely long legs or an abnormally high metabolism, for instance, had advantages as well as disadvantages.

Those were the two kinds of children in Southvale and, by report, the world. A third pitiful group hardly counted, that of hopelessly crippled mutants, born with some handicap of mind or body which usually killed them in a few years.

At first, the tide of abnormal births following the war had brought only horror and despair. Infanticide had run rampant, but today, there were asylums for unwanted children. People knew their child had about three chances in four of being mutant to a greater or less degree—but, after all, there *could* be a human, if not this time then next—or even a genuinely favorable mutation.

But Wayne had not seen or heard of any such, and doubted that he ever would. There were so many ways of not doing something, and even an unquestionably good characteristic seemed to involve some loss elsewhere. Like the Martin kid, with his eagle-keen eyes and total deafness.

He waved to that boy, running along with the mutant band, and got an answer. The rest ignored him.

Mutants were shy of humans, often resentful and suspicious. And one could hardly blame them. This first generation had been hounded unmercifully by the normal children as it grew up, and had had to endure a lot of abuse and discrimination on the part of adults. No wonder they drew together, and said little to anyone except their fellows. Today, with most of their persecutors grown up, the mutants were a majority among the children, but they still had nothing to do with humans of their generation beyond a few fights. The older ones generally realized that *they* would inherit the earth, and were content to wait. Old age and death were their allies.

But Alaric—The old uncertain pain stirred in Wayne. He didn't know. Certainly the boy was mutant; an Xray, taken when the town machine had recently been put back into service, had shown his internal organs to be reversed in position. And apparently the mutation involved moronic traits, for he spoke so little and so poorly, had flunked out of elementary school, and seemed wholly remote from the world outside him. But—well, the kid read omnivorously, and at tremendous speed if he wasn't just idly turning pages. He tinkered with apparatus Wayne had salvaged from the abandoned college labs, though there seemed to be no particular purpose to his actions. And every now and then he made some remark which might be queerly significant—unless, of course, that was only his parents' wishful thinking.

Well, Alaric was all they had now. Little Ike, born before the war, had died of hunger the first winter. Since Al's birth they'd had no more children. The radioactivity seemed to have a slow sterilizing effect on many people.

Karen met them at the door. The mere sight of her blond vivacity lifted Wayne's spirits. "Hello, gentlemen," she said. "Guess what?"

"I wouldn't know," answered Wayne.

"Government jet was here today. We're going to get regular air service."

"No kidding!"

"Honest Injun, I have it straight from the pilot, a colonel no less. I was down by the port, on the way to market, about noon, when it landed, and of course forced my way into the conversation."

"You wouldn't have to," said Wayne admiringly.

"Flatterer! Anyway, he was informing the mayor officially, and a few passers-by like myself threw in their two bits' worth."

"Hm-m-m." Wayne entered the house. "Of course, I knew the government was starting an airline, but I never thought we'd get a place on it even if we do have a cleared area euphemistically termed an airport."

"Anyway, think of it. We'll get clothes, fuel, machinery, food—no. I suppose we'll be shipping that ourselves. Apropos which, soup's on."

It was a good meal, plain ingredients but imaginative preparation. Wayne attacked it vigorously, but his mind was restless. "Funny," he mused, "how our culture over-

reached itself. It grew top-heavy and collapsed in a war so great we had to start almost over again. But we had some machines and enough knowledge to rebuild without too many intervening steps. Our railroads and highways, for instance, are gone, but now we're replacing them with a national airline. We'll likewise go later directly from foot and horseback to private planes."

"And we won't be isolated any more, contacting the outside maybe four times a year. We'll be part of the world again."

"Mm-m-m—what's left of it, and that isn't much. Europe and most of Asia, they tell me, are too far gone to make intercourse worthwhile or even possible. The southern parts of this country and the greater part of Latin America are still pretty savage. Most people who survived the war migrated there later, to escape cold and hunger. Result—overcrowding, more famine, fighting and general lawlessness. Those who stuck it out here in the north and stayed alive came out better in the end."

"It'll be a curious new culture," said Karen thoughtfully. "Scattered towns and villages, connected by airlines so fast that cities probably won't need to grow up again. Stretches of wild country between, and—well, it'll be strange."

"Certainly that. But we can hardly extrapolate at this stage of the game. Look, we here in Southvale, and a lot of similarly circumstanced places, have been able to relax for some ten years now. Blights and bugs and plagues pretty well licked, outlaws rounded up or gone into remote areas—Well, we've been back on our feet that long. Since then, the process of re-integrating the country has gone ahead pretty steadily. We're no longer isolated, as you said. With the government center in Oregon as a sort of central exchange, we've been able to trade some of the things we have for what we need, and now this regular airline service will be the way to a national economy. Martial law was . . . ah . . . undeclared nine years ago, and the formal unification of the United States, Canada, and Alaska carried out then. You and I helped elect Drummond to President last time, when the poll plane came around."

"I know a little of that already, O omniscient one. What is all this leading up to?"

"Simply that in spite of all which has been accomplished, there's still a long ways to go. South of us is anarchic barbarism. We have precarious contact with some towns in Latin America, Russia, China, Australia, and South Africa, otherwise we're an island of, shall I say, civilization in a planetary sea of savagery and desolation. What will come of that? Or still more important—what will come of the mutants?"

Karen's eyes were haggard as they searched Alaric's unheeding face. "Perhaps at last—the superman," she whispered.

"Not at all probable, dear. You read the official book explaining this thing. Since most mutations are recessive, though they do tend to follow certain patterns, there must

have been an incredible totality of altered genes for so many to find their mates and show up in the first generation. Even after the radioactivity is gone, there'll be all those unmatched genes, waiting for a complement to become manifest. For several centuries, there'll be no way to tell what sort of children any couple will have, unless the geneticists figure out some system we don't even suspect at present. Even then, the mutated genes would still be there; we couldn't do anything about that. God only knows what the end result will be—but it won't be human."

"There may be other senses of that word."

"There will be, inevitably. But they won't be today's."

"Still—if all the favorable characteristics showed up in one individual, he'd be a superman."

"You assume no unfavorable ones, possibly linked, will appear. And the odds against it are unguessable. Anyway, what is a superman? Is he a bulletproof organism of a thousand horsepower? Is he a macrocephalic dwarf talking in calculus? I suppose you mean a godlike being, a greatly refined and improved human. I grant you, a few minor changes in human physique would be desirable though not at all necessary. But any semanticist will tell you Homo sapiens are a million miles from realizing his full mental capacities. He needs training right now, not evolution.

"In any case," finished Wayne grayly, "we're arguing a dead issue. Homo sapiens have committed race suicide. The mutants will *be* man."

"Yes—I suppose so. What do you think of the steak?"

Wayne settled down in his easy-chair after supper. Tobacco and newspapers were not being produced, and the government was still taking all the radios made in its new or revived factories. But he had a vast library, his own books and those he had salvaged from the college, and most of them were timeless. He opened a well-thumbed little volume and glanced at lines he knew by heart.

"For a' that an a' that,
It's comin' yet for a' that,
When men to men, the whole world o'er,
Shall brothers be for a' that."

I wonder. How often I've wondered! And even if Burns was right, will the plowman's common sense apply to nonhumanness? Let's see what another has to say—

"And we, that now make merry in the Room
They left, and Summer dresses in new bloom,
Ourselves must we beneath the Couch of Earth
Descend—ourselves to make a Couch—for whom?"

His gaze descended to Alaric. The boy sprawled on the floor in a litter of open books. His eyes darted from one to another, skipping crazily, their blankness become a weird blue flicker. The books—"Theory of Functions," "Nuclear Mechanics," "Handbook of Chemistry and Physics," "Principles of

Psychology," "Rocket Engineering," "Biochemistry." None of it could be skimmed through, or alternated that way. The greatest genius of history couldn't do it. And a senseless jumble like that—No, Alaric was just turning pages. He must be—a moron?

Well, I'm tired. Might as well go to bed. Tomorrow's Sunday—good thing we can take holidays again, and sleep late.

There were a good fifty men in Richard Hammer's gang, and about ten women equally gaunt and furtive and dangerous. They moved slowly along the riverbank, cursing the rocks they stumbled on, but in a ferocious whisper. Overhead a half moon gave vague light from a cloudy sky. The river sped on its way, moonlight shimmering fitfully off its darkness, and an uncertain wind ghosted through soughing trees. Somewhere a dog howled, and a wild cow bellowed alarm for her calf—descendants of domestic animals that ran free when their masters fled or died. And most savage of all the creatures moving through that night were the humans who had likewise been thrust back into wildness.

"Dick! How much longer, Dick?"

Hammer turned at the low call and scowled back at the uncertain shapes of his followers. "Shut up," he growled. "No talkin' on march."

"I'll talk when I please." The voice was louder.

Hammer hunched his great shoulders and thrust his battered hairy face aggressively into the moonlight. "I'm still boss," he said quietly. "Anytime you wanta fight me for the job, go ahead."

He had their only remaining firearm, a rifle slung over his back and a belt of a few cartridges, but with knife and club, fists and feet and teeth he was also the deadliest battler in the gang. That was all which had kept him alive, those unending dreadful years of feud and famine and hopeless drifting, for no gangman was ever safe and a boss, with his own jealous subordinates to watch as well as outsiders, least of all.

"O.K., O.K.," yielded the other man sullenly. "Only I'm tired an' hungry, we been goin' so long—"

"Not much farther," promised Hammer. "I rec'nize this territory. Come on—an' quiet!"

They moved ahead, stumbling, half asleep with weariness, and the terrible gnawing void in their bellies was all that kept them going. It had been a long journey, hundreds of miles of devastated southland, and it was hard, bitterly hard to pass these comparatively rich farms without lifting more than a few chickens or ears of corn. But Hammer was insistent on secrecy, and he had dominated them long enough for most of them to give in more or less automatically. He had not yet chosen to reveal his plans, but this far into "enemy" country they must involve fighting,

The moon was lowering when Hammer called a halt. They had topped a high ridge overlooking a darker mass some two miles off, a town. "You can sleep now," said

the chief. "We'll attack shortly before sunrise. We'll take the place an' then—food! Houses! Women! Likker! An' — more."

The gang was too tired then to care about anything but sleep. They stretched on the ground, lank animal figures in clumsy garments of leather and ragged homespun, carrying knives and clubs, axes, even spears and bows. Hammer squatted motionless, a great bearded gorilla of a man, his massive face turned toward the sleeping town. A pair of his lieutenants, lean young men with something hard and deadly

in their impassive countenances, joined him.

"O.K., Dick, what's the idea?" muttered one. "We don't just go tearin' in; if that was all, there're towns closer to where we came from. What're you cookin' now?"

"Plenty," said Hammer. "Now don't get noisy, an' I'll explain. My notion'll give us more'n a few days' food an' rest an' celebration. It'll give us—home."

"Home!" whispered the other outlaw. His cold eyes took on an odd remote look. "Home!" The word tastes queer. I ain't spoke it so long—"

"I useta live here, before the war," said Hammer softly and tonelessly. "When things blew up, though, I was in the army. The plagues hit my unit, an' those who didn't die the first week went over the hill. I headed south, figgerin' the country'd busted up an' I'd better go where it'd be warm. Only too many other people got the same idea."

"You've told us that much before."

"I know, I know, but—anybody who lived through it can't forget it. I still see those men dyin'—the plague eatin' 'em. Well, we fought for food. Separate gangs attacked when they met. Until at last there were few enough left an' things picked up a little. So I j'ined the village an' tried farmin'."

The dog howled again, closer. There was an eerie quavering in that cry, something never voiced before the mutations began. "That mutt," growled one of the gangmen, "will wake the whole muckin' town."

"Nah, this place has been peaceful too long," said Hammer. "You can see that. No guards nowhere. Why, there're sep'rate farms. *We* had to fight other men, an' then when we finally settled down it was the bugs an' blights, an' at last the floods washed our land from under us an' we had to take to gang life again. Then I remembered my ol' home town Southvale. Nice farmin' land, not too bad weather, an' judgin' by reports an' rumors about this region, settled down, a'most rich. So I thought I'd come back—Hammer's teeth gleamed white under the moon.

"Well, you always did love t'hear y'rself talk. Now suppose you say what your deal is."

"Just this. The town's cut off from outside by ordinary means. Once we hold it, we can easy take care o' the outlyin' farms an' villages. *But*—you can see the gov'ments's been here. Few bugs in the crops, so somebody must'a been sprayin'. A jet overhead yesterday. An' so on."

They stirred uneasily. One muttered, "We don't want no truck with the gov'ment. They'll hang us f'r this."

"If they can! They're really not so strong. They ain't got aroun' to the South at all, 'cept f'r one or two visits. Way I figger it there's only one gov'ment center to speak of, this town out in Oregon we heard about. We can find out 'zac'ly

from the people we catch. They'll tell!

"Now look. The gov'ment must deal with Southvale, one way 'r 'nother. There ain't enough cars 'r roads, they must use planes. That means one'll land in Southvale, sooner 'r later. The pilot steps out—an' we've got us a plane. I ain't forgot how to fly. A few o' us 'r maybe we can ferry a lot, fly to Oregon an' land at night near the house o' some big shot, the President even, whoever he is. The plane's pilot'll tell us what we need to know. Those jets just whisper along, an' anyway nobody expects air attack any more. We'll be just another incomin' plane if they do spot us.

"We capture our big shot, an' find out from him where the atom bombs're kept. There must be some stockpiled near the city, an' our man'll make a front f'r us to get at 'em. If he ain't scared f'r himself, he's got a family. We set the bombs an' clear out. The city blows. No more gov'ment worth mentionin'. With what we've taken from the arsenals, we'll hold Southvale an' all this territory. We'll be be bosses, owners—kings! Maybe later we c'n go on an' conquer more land. There'll be no gov'ment t' stop us."

He stood up. His eyes caught the moonlight in a darkly splendid vision of power and destiny, for he was not, in his own estimate, a robber. Hardened by pain and sorrow and the long bitter fight to stay alive, he was more of a conqueror, with the grandiose dreams and at least something of the driving energy and transcendent genius of an Alexander or a Napoleon. He genuinely hoped to improve the lot of his own people, and as for others—well, "stranger" and "enemy" had been synonymous too long for him to give that side of it much thought now.

"No more hunger," he breathed. "No more cold an' wet, no more hidin' an' runnin' from a stronger gang, no more walkin' an' walkin' an' never gettin' nowheres. Our kids won't die before they're weaned, they'll grow up as God meant they should, free an' happy an' safe. We c'n build our own future, boys—I seem t' see it now, a tall city reachin' f'r the sun."

His lieutenants stirred uneasily. After some ten years of association they recognized their chief's strange moods but could not fathom them. His enormous ambitions were beyond the scope of minds focused purely on the daily struggle for life, they were awed and half afraid. But even his legion of enemies and rivals acknowledged Hammer's skill and audacity and luck. This might work.

Their own ideas of a future went little beyond a house and a harem, But to smash the government was a cause worth giving life for. They associated it with the disaster, and thus with all their woes. And it was their enemy. It would kill them, or at least lock them up, for deeds done when life depended on ruthless action. It would certainly never permit them to hold this green and lovely land.

Unless—unless!

The dog had been snuffling around the outlaw camp, a vague misshapen shadow in the fleeting moonlight. Now he howled once more and trotted down the ridge toward the dark silent mass of the town.

Alaric Wayne woke up at the sound of scratching. For a moment he lay in bed, mind still clouded with sleep. Moonlight streamed through the window to shimmer off the tumbled heaps of books and apparatus littering the room. Outside, the world was a black and white fantasy of bulking shadow, dreaming off into the remote star-torched sky.

Full wakefulness came. Alaric slid out of bed, went to the window, and leaned against the screen. It was his dog, scratching to get in. And—excited. He raised the screen and the animal jumped clumsily over the sill.

The dog whined, pulled at Alaric's leg, sniffed toward the south and shivered. The boy's great light eyes seemed to deepen and brighten, flash cold in the pouring moonlight; shadow-masked, his thin face was not discernible, but its habitual blankness slid into tight lines.

He had to —think!

The dog was warning him of danger from the south. But, though the mutation shaping the canine brain had given it abnormal intelligence, he was still a dog, not qualitatively different from the rest of his species, not able to understand or reason above an elementary level. Three years before, Alaric had spotted qualities in the pup by certain signs, and raised and trained it, and there was a curious half-rapport between them, a mutual understanding. They had co-operated earlier, on their long hikes, to hunt or to avoid the wild dog packs, but now—

There was danger. Men outside town, to the south, with hostile intentions. That was all the dog had been able to gather. It would have been enough for any normal human, as a basis of action. But Alaric wasn't normal.

He stood shivering with effort, clenching his hands to his forehead as if to prevent a physical disintegration of his frantically groping brain. What did it mean? What to do?

Danger—danger was clear enough, and primitive instinct revealed the action one must take. One ran from the packs of human boys when they intended to commit mayhem on a mutant, and hid. One skirted the spoor of wild dogs or the bears beginning to spread since hunting fell off. Only in this case —slowly, reluctantly, fighting itself, his shuddering mind spewed out the conclusion—in this case, one couldn't run. If the town went, so did all safety

Think—*think!* There was danger, it couldn't be run from—what to do? His mind groped in fog and chaos. It could grasp at nothing. Disjointed logic chains clanked insanely in his skull.

Reason did not supply the answer, but instinct came, the instinct which

would have surged to the fore under the pressure of immediate peril, and now finally broke through the swirling storm of a mind trying to think.

Why—it was so simple. Alaric relaxed, eyes widening with the sheer delightful simplicity of it. It was, really, as obvious as—why, it had all the primitive elementariness of the three-body problem. If you couldn't run from danger— you fought it!

Fighting—destruction—yes, something to destroy, but he would only have the newly reclaimed powerhouse available—

He scrambled into his clothes with frantic speed. A glance at stars and moon told him, without his thinking about it, how long to sunrise. Not long— and in his own way he knew the enemy would attack just before dawn. He had to hurry!

He vaulted out the window and ran down the silent street, the dog following. All the town's electrical and electronic equipment was stored at the powerhouse. It would be quite a while before the whole community had electricity again, but meanwhile the plant ran several important machines, charged storage batteries, and performed other essential services.

The building stood beside the river, the only lit windows in town besides the police station glowing from its dark bulk. After the war there had been no time, supplies, or parts to spare for the generators, and they had been plundered to repair the vital farm equipment, but recently the government had delivered what was necessary to get the water turbines going again. It had occasioned a formal celebration in Southvale—another step up the ladder, after that long fall down.

Alaric beat on the door, yelling wordlessly. There came the sound of a scraping chair and the maddeningly slow shuffle of feet. Alaric jittered on the steps, gasping. No time, no time!

The door creaked open and the night watchman blinked myopically at Alaric. He was an old man, and hadn't gotten new glasses since the war. "Who're you?" he asked. "And what do you want at this hour?"

Alaric brushed by unheedingly and made for the storeroom. He knew what he needed and what he must do with it, but the job was long and time was growing so desperately short.

"Here . . . hey, you!" The watchman hobbled after him, shaking with indignation. "You crazy mutie, what do you think you're doing—?"

Alaric shook loose the clutching hand and gestured to his dog. The mongrel snarled and bristled, and the watchman stumbled back, white-faced. "Help!" It was a high, old man's yell. "Help, burglar—"

Somehow words came, more instinctive than reasoned. "Shut up," said Alaric, "or dog kill you." He meant it.

The animal added emphasis with a bass growl and a vicious snap of fangs. His head reeling, his heart seeming to burst his ribs,

the watchman sank into a chair and the dog sat down to watch him.

The storeroom door was locked. Alaric grabbed a heavy wrench and beat down a panel. Tumbling into the storeroom, he grabbed for what he needed. Wire—meters—electronic tubes—batteries—*hurry, hurry!*

Dragging it out into the main room before the great droning generators, he squatted down, a tatterdemalion gnome, eyes like blued metal, face tautened into a savagery of concentration, and got to work. Through a visual blur, the guard stared in uncomprehending terror. The dog watched him steadily, with sullen malevolent hope that he would try something. It was embittering, to hate all the world save one being, because only that being understood—

False dawn glimmered wanly over the land, touching houses and fields with wandering ghost fingers, glittering briefly off the swift-flowing river before deeper darkness returned. Hammer's gang woke with the instant animal alertness of their kind, and stirred in the fog-drifting twilight. Their scant clothes were heavy with dew, they were cold and hungry—how hungry!—and they looked down at the moveless mass of their goal with smoldering savage yearning.

"Fair is the land," whispered Hammer, "more fair 'n land's ever been. The fields 're green t' harvest an' the fog runs white over a river like a polished knife—an' it's our land, our home." His voice rose in hard snapping command: "Joe, take twenty men an' circle north. Come in by the main road, postin' men at the edge o' town an' the bridge over the river, then wait in the main square. Buck, take your fifteen, circle west, an' come in the same time as Joe, postin' men outside town an' in that big buildin' halfway down Fifth Street—that's the machine shop, as I recall, an' I *hope* you c'n still read street signs. Then join Joe. The rest follow me straight no'th. Go as quiet as you can, slug 'r kill anyone you meet, an' be ready f'r a fight but don't start one. O.K.!"

The two other groups filed down the hill and vanished into misty dusk. Hammer waited awhile. He had previously divided the gang into bands assigned to his lieutenants, reserving the best men for the group immediately under him. He spoke to them, softly but with metallic rapidity:

"Accordin' t' what I remember o' Southvale, an' to what I seen elsewhere, they don't expect nothin' like this. There've been no bandits here f'r a long time, an' anyway they'd never think a gang had the skill and self-control t' sneak through the fat lands farther south. So there'll be no patrol, just a few cops on their beats—an' too sleepy this time t' give us much trouble. An' nearly all the weapons 're gonna be in the police station—which is what we're gonna capture. With guns, we'll control the town. But f'r the love of life, don't start shootin' till I say to. There may be armed citizens, an' they c'n raise hell

with us 'nless we handle 'em right."

A low mutter of assent ran along that line of haggard, bearded, fierce-eyed men. Knives and axes glittered in the first dim dawn-flush, bows were strung and spears hefted. But there was no restlessness, no uncontrollable lust to be off and into battle. They had learned patience the hard way, the last sixteen years. They waited.

Timing wasn't easy to judge, but Hammer had developed a sense for it which had enabled him to pull several coups in the past and served him now. When he figured the other groups were near the outskirts of town, he raised his hand in signal, slipped the safety catch on his gun, and started down the hill at a rapid trot.

The white mists rolled over the ground, but they needed nothing to muffle the soft pad of their feet, most bare and all trained in quietness. Grass whispered under their pace, a staked-out cow lowed, and a rooster greeted the first banners of day. Otherwise there was silence, and the town dreamed on in the cool twilight.

They came onto the cracked pavement of the road, and it was strange to be going on concrete again. They passed an outer zone of deserted houses. As Hammer had noticed elsewhere, Southvale had drawn into a compact defensive mass during the black years and not grown out of it since. As long as there were no fortified outposts, such an arrangement was easy to overrun. Still, the outlaws were enormously outnumbered, and had to counterbalance the disadvantage by the cold ruthlessness of direct action. Hammer stopped at the edge of habitation, told off half a dozen men to patrol the area, and led the rest on to the middle of town. They went more slowly now, senses strainingly alert, every nerve and muscle taut with the expectancy of danger.

Hoofs clattered from a side street. Hammer gestured to a bowman, who grinned and bent his weapon. A mounted policeman came into view a few blocks down. He wasn't impressive, he had no sign of office except gun and tarnished badge, he was sleepy and eager to report to the station and then get home. His wife would have breakfast ready—

The bow twanged, a great bass throb of music in the silent misty street. The policeman pitched out of his saddle, the arrow through his breast, the astonishment on his face so ridiculous that a couple of gangmen guffawed. Hammer cursed; the horse had reared, screamed, and then galloped on down the street. The clattering echoes beat at the walls of the house like alarm-crying sentries.

A man stuck his head out the window of a dwelling. He was drowsy, but he saw the unkempt band outside and yelled—a choked gurgle it was, drowned in an arrow's blood-track before it had been properly born.

"Snagtooth an' Mex, get in that house an' silence anyone else!" rapped Hammer. "You five"—he swept an arm in an unconsciously

imperial gesture—"take care o' anyone else here who heard. The rest *come on!*"

They ran down the street, disregarding noise but not making much anyway. The town had changed considerably, but Hammer remembered the layout. The police station, he thought briefly and wryly, he knew very well—just about every Saturday night, in the old days.

They burst onto that block and raced for the station. There it was, the same square and solid structure, dingy now with years, the trimmings gone, but there were horses hitched before it and the door stood ajar—

Through the door! The desk sergeant and a couple of men gaped blankly down the muzzle of Hammer's gun, their minds refusing to comprehend, their hands rising by stunned automatism. Others of the gang poured down the short halls, into every room. There came yells, the clatter of feet, the brief sharp bark of a gun and the racket of combat.

Hoofs pounded outside. A gun cracked, and one of Hammer's men standing guard at the door, fell. Hammer himself jumped to the window, smashed the glass of it with his rifle butt, and shot at the half-dozen or so mounted police outside—returning from their beats, no doubt, and alarmed at what they saw.

He had little opportunity to practice. Shells were too scarce. His first shot went wild, the second hit a horse, the third was as ineffectual as the first. But the police did retreat. They weren't such good shots either, though a couple of slugs whined viciously close, through the window and thudding into the wall beyond.

"Here, Dick!" His men were returning from the interior of the building, and they bore firearms, bore them as they would something holy and infinitely beautiful, for these were the way to a life worth living. "Here—shootin' weapons!"

Hammer grabbed a submachine-gun and cut loose. The troopers scattered, leaving their dead, and fled down the streets. And there were those other two bands entering—Hammer laughed for sheer joy.

"We got the whole station," reported one of his men. "Bob got it in the leg, an' I see they plugged Little Jack an' Tony. But the place is ours!"

"Yeah. Lock up these cops, take what weapons an' horses you need, an' ride aroun' town. Herd ever'body down into the main square in the center o' town. Be careful, there'll be some trouble an' killin', but we don't have to be on the receivin' end o' any o' it. Mart, Rog, an' One-Ear, hold the station here an' look after our wounded, Sambo an' Putzy, follow me. I'm goin' t' the square now to—take possession!"

There was noise in the street, running and stamping feet, shouts and oaths and screams. Now and then laughter or gunfire. Roderick

Wayne gasped out of sleep, sweating. What a dream! Nightmare recollection of the black years—

No dream!

There was a tremendous kicking and beating on the door, and a voice bawling in some uncouth accent: "Open up in there! Open up in the name o' the law!"

More laughter, like wolves baying. Someone yelling. A cry that choked off into silence. Wayne jumped out of bed. Even then he was dimly surprised to find he wasn't shaking and gibbering in blind panic. "Get Al, Karen," he said. "Stay inside, in a back room. I've got to look into this."

He stopped in the living room to get his rifle. It was only a souvenir now, few cartridges left, but he had killed men with it in the black years. *And must I go through that again? No—please not!*

Wood split and crashed, and a man leaped into the house over the fallen door. Wayne saw the pistol and dropped his own unloaded rifle. He remembered such ragged figures, the shaggy wolf-eyed men whose weapons were all too ready. The outlaws had returned.

"Smart," nodded the gangman. "'Nother see 'n' I'd'a scragged you. Outside."

"What . . . is . . . this?" Wayne's lips were stiff.

"Get out!"

Wayne went obliquely, praying he could draw the bandit out of the house. "If it's loot you want," he said, fighting to keep his voice level, "I'll show you where the silver is."

Another gangman entered. He had abondoned his unaccustomed gun for his old ax. "Ever'body out o' here?" he asked.

"I just got in," said the first. "I'll search it myself. Find y'r own house." He turned on Wayne and slammed him in the stomach with one fist, "Scram, you—down t' the main square!"

Retching, Wayne staggered back, and outside mostly by chance. Sick and dizzy, head roaring like his collapsing world, he leaned against the wall.

"Rod!"

He turned, unbelieving. Karen had just come around the side of the house, pale but outwardly composed. "Are you all right, Rod?" she whispered.

"Yeah . . . yeah . . . but you . . . how—?"

"I heard them talking and slipped out a window. But Rod—Al's gone."

"Gone!" Briefly, new dismay shook Wayne. Al—whatever the mutant was, Al was his son. Then relief came, realization. "He must have sneaked out, too. He's all right. He knows how to run and hide—all mutant kids learn that." His mind added grayly: *And in the next generation all human kids will have to learn it.*

"But us—Rod, what is this?"

Wayne shrugged and started down the street. "Town's apparently captured," he said.

"Outlaws—we have to run, Rod! Have to get away!"

"Not much use, I'm afraid. This is the work of a well-disciplined group under a smart leader. They must have come up from the south, resisting the temptation to plunder on the way. They took us by complete flat-footed surprise, overpowered the police—I recognized Ed Haley's pistol in that bandit's hand—and are now rounding us up in quite a methodical fashion. I wasn't just shoved out, I was ordered

to report to the square. That suggests they're guarding all ways out. Anyway, we can't flee right now."

They had fallen in with a group of citizens moving with the dumb blank obedience of stunned minds toward the square under outlaw guard. The gang was having little trouble. They went from house to house, forcing the inhabitants into the street. The work went fast.

There was fighting now and then, short and sharp, ending in blow of club or knife or bullet. A couple of families with guns stood off the invaders. Wayne saw fire arrows shot into the roofs of those houses.

He shuddered and bent his head to Karen's ear. "We do have to get out as soon as we can," he muttered. "*If* we can. They're disciplined now, and wholly merciless. Once we're completely rounded up, the discipline will break but the ruthlessness stay in such an orgy of looting and drinking, burning and rape and murder, as has always followed barbarian conquests."

"They can't stay long," she answered desperately. "The government . . . this is on the air route—"

"That's what I can't figure out. They must know they can't remain, so why did they come here in the first place? Why not raid the lands closer to home? Well—we'll have to see, that's all."

The—herd—of citizens entered the square and walked toward the little memorial in its center with the queer blind shuffle that cattle in a stockyard chute have. There were other outlaw guards posted around the square and on the memorial, weapons ready. The monument was a granite shaft with a stone bench on each side, and seated there—

Wayne did not remember the bearded giant, but Karen caught a sudden gasp of recognition. "It . . . it . . . Rod, it's Hammer. Richard Hammer!"

"Eh?"

"Don't you recall—the mechanic at the service station—we always used to get our gas there, and once when I smashed a fender on the car he fixed it so you wouldn't notice—"

The chief heard them. There weren't many people in the square yet, and the early sun struck dazzling off Karen's hair. "Why, it's Miz' Wayne," he said. "Howdy Miz' Wayne."

"H-h-hello," faltered Karen.

"Lookin' purtier 'n ever, too. Wayne, you had all the luck."

The mathematician shouldered his way forward, suddenly weak with a dreadful clawing fear. "Hammer—what is this?" he got out.

"I'm takin' over Southvale. Meet y'r new boss."

"You—" Wayne swallowed. He choked down the panic rising in him and said in a level, toneless voice: "I gather you've become chief of this band and led it back here for a raid. But—you must know you can't get away with it. We're on an airline route. The government will know."

Hammer smiled wearily. "I've figgered all that out. I intend to

stay here. I'm gatherin' all the folks t' tell 'em t' be good, because we don't mind killin'. But if y're really interested—" He sketched his further plans.

"You're crazy—it's not possible."

"A lot o' less possible things have happened. If you all, not too far no'th, felt safe, what about the gov'ment 'way out in Oregon? We'll do it!"

"But even if you can—Hammer, do you realize the government is the only link left with our past, our civilization? You'd throw man back a thousand years."

"So what? Wayne, don't you nor anybody else hand me none o' that crap 'bout law an' order an' humanity. You're fifteen years too late. You an' your kind made us outlaws, drivin' us away when we came starvin' to you, houndin' us south an' then in your fat smugness forgettin' about us. It's been hard, Wayne, battle an' death an' hunger all those years. We had t' get hard ourselves, t' stay alive."

"You could have stuck it out in the north as we did, and raised your own food free from most bandits."

"Free only because so many people like us went south. Nor were most o' us farmers, with land an' equipment an' experience. Anyway you did drive us out when you were strong. I ain't blamin' you. You had t' live. But it's our turn now, so shut up." Hammer's eaglesque eyes swung to Karen, he smiled. It was a winter-cold smile, warmth and humor had died long ago in him. "You, I'll be seein' more of," he said. "It's been so long—"

The square was well filled with people now, and more were arriving and being herded into side streets and buildings. Some were still numb. Some wept or prayed or implored or tried to ingratiate themselves, some cursed and threatened, some retreated into impassive silence. But—prisoners all. Captured, impotent, legitimate prey.

Hammer turned as an outlaw galloped up, thrusting his horse through the crowd without regard for their safety. "What is it?" asked the chief, not anxiously. His victory was too tremendously evident.

"I dunno—some trouble down by the river," said the gangman. "About half Joe's detail ain't showed up yet."

"Hm-m-m? Musta found some likker."

"Yeah—Hey—*What's that?*"

Hammer turned. He couldn't see much sitting down. Huge and shaggy and ablaze with the arrogance of his triumph, he sprang lithely onto the bench and looked north along the street. He grinned, then laughed, then shouted with humorless mirth. "Lamp that, boys. Some crazy mutie—*look* at him!"

Wayne was so placed that he could also see down that street. His heart staggered, for a black instant he couldn't believe, refused to comprehend, then—

"Alaric."

The boy was coming down the street, walking slowly and carrying

an object, a fantastic wire-tangled grotesquerie of electronic surrealism, thrown together in the wildest haste and with no recognizable design. A wire led from it to a reel of cable mounted on a mule's back, and the cable snaked behind, along the road—it must go clear to the powerhouse!

How had Al done it? That cable was sacrosanct, reserved for electrifying the airport. That apparatus, the invaluable parts in it—how had he gotten them? How—why? *Why?* What mad vagary of a reasonless brain had prompted him to go thus on this darkest of mornings? What—

"Come on, kid," shouted Hammer boisterously. "Whatcha got?"

Alaric came closer. His delicately cast features were set in concentration, his strange light eyes flashing like glacial ice, not a human gleam. He lifted his device and twirled a pair of dials.

"May be a weapon," said a bandit uneasily and raised his rifle.

"Not . . . Alaric—" It was a hoarse cry from Wayne's throat, and he made a clumsy lunge for the outlaw. Hammer swept one long arm in a careless blow and sent him crashing to the ground.

The gangman squeezed the trigger on his rifle but never completed the motion. He was dead before that. Wayne, sprawled on his back, looking up through a whirling fog of grief and horror and hopeless defeat, saw the man's body explode.

It went up in a white burst of steam, a crash of rending bone and tissue and a brief glare of incandescence. The rifle flying from him glowed cherry red, blowing up as its cartridges detonated. Before the fragments had fallen, *something* had swept the outer edges of the square, and where the guards had stood were steam-clouded heaps of charred bone and shredded flesh.

The crowd yelled, a single beast cry half of terror, half of surging death-lusting triumph, and swept down on the remaining gangmen. Most were too demoralized to resist. Others struggled, and got a few townspeople before they were trampled under.

Hammer roared, the bellow of a pain-crazed bull, as the mob raged toward him. A horse reared as its outlaw rider was yanked from the saddle. Two slugging blows, and Hammer had cleared a way to the mount. He sprang upon its back, howling, and the attackers fell away from his insane charge.

Almost, he made it. He was on the edge of the square when a man whose brother had been killed made a long jump and grabbed the horse's bridle—grabbed it, and hung on till a dozen men held the gang boss secured.

Only one or two outlaws escaped. The rest, with the town in no mood for trials, were hanged that afternoon. Hammer asked not to be blindfolded, and they granted him that much. To the end, he stood looking out over the sun-glittering river, the rolling tree-clad hills, and the fair broad land green to harvest.

Wayne took no part in the executions. He had other things to think about.

After the celebrations, the unending parades and parties and speeches, the reorganization and the defense tightening, there was a rather grim conference in Wayne's house. He and Karen were there, seated together before the fire, and Alaric sat opposite them, nervous and bewildered. A government representative was present, a lean man who looked older than he was, Robert Boyd by name and roving presidential agent by profession. In the corner, shadow-cloaked and unnoticed, squatted the shaggy troll-shape of the dog, his sullen eyes brooding redly on the others.

"You've heard the official account," said Wayne. "Alaric, a mutant *idiot savant,* invented and built a weapon to defeat the outlaws. He's been much made of, and nobody pays any attention to Pop Hanson—he's the powerhouse watchman, and was rather rudely treated. One must make allowance for the eccentricity of genius, or so they say."

"Well, one must," nodded Boyd.

"Hardly. If so many of our people hadn't died, I'd say this was a good thing. It taught us not to be complacent and careless. More important, it at least indicated that mutants can serve society as talented members." Wayne's eyes were haggard. "Only, you see, Al didn't behave like a genius. He acted like a low-grade moron."

"Inventing that—"

"Yes, going all around Robin Hood's barn, committing violence and theft, working like a slave, risking his neck, all to build that weapon and use it. But he told me his dog warned him hours ahead of time. Certainly he was at the powerhouse early. Don't you see, we could have been ready for the outlaws, we could have stood them off, driven their ill-armed force away with no loss to us *if Alaric had merely gone to the police with that warning.*"

Thunderstruck, Boyd swung his eyes to meet the blue vacancy of Alaric's. "Why . . . why didn't you?"

The boy stared, slowly focusing his vision and mind, face twisted with effort. He . . . his father had told him the day before . . . what was it now? Yes—"I . . . didn't . . . think of it," he fumbled.

"You didn't think of it. It just never occurred to you." Dazed, Boyd turned to Wayne. "As long as you said it yourself, I agree—*idiot savant.*"

"No." Karen spoke very quietly. "No, not in any ordinary sense. Such a person is feeble-minded in all but one respect, where he is brilliant. I used to teach school, and know a little psychology. Yesterday I gave Al some special tests I'd worked out. Science, mechanical skill, comprehension—in too many respects he's a genius."

"I give up. What *is* he, then?"

"A mutant," said Karen.

"And . . . this weapon—?"

"Alaric tried to tell me, but we couldn't understand each other," said Wayne. "And the thing itself burned out very quickly in use. It's just fused junk now. From what I could gather, though, and by deduction on that basis, I think

it projected an intense beam of an inconceivably complex wave form to which one or more important organic compounds in the body resonate. They disintegrated, releasing their binding forces. Or perhaps it was body colloids that were destroyed, releasing terrific surface energies. I'm just as glad I don't know. There are too many weapons in the world."

"Mm-m-m—officially I can't agree with you, but privately I do. Anyway, the inventor is still here—the genius."

"It takes more than genius," said Wayne. "It just isn't possible for any human being to sit down and figure such a thing out in detail. All the facts are available, in handbooks and texts and papers—quantum mechanics, circuit characteristics, physical constants. But even if he knew exactly what he was after, the greatest genius in the world would have to spend months or years in analytical thought, then more time in putting all those facts together into the pattern he was after. And even then he wouldn't know it all. There'd be a near infinitude of small factors interacting on each other, that he couldn't allow for. He'd have to build a model and experiment with it, the empirical process known to engineers as getting the bugs out.

"In his incoherent way, Alaric told me his only difficulty was to figure out what to do to meet the danger. All he could think of was to make some kind of weapon. But he hardly spent a second working out the details of that devil's engine, and his first model was as nearly perfect as his inadequate tools and materials permitted. He *knew* how to make it."

With a shuddering effort, Boyd relaxed. He couldn't look at that small, big-headed figure in the armchair. The ancient human dread of the unknown was too strong in him. He asked slowly:

"What's the answer, then?"

"Karen and I think we've figured it out, and what little Al can tell us seems to confirm our idea. But I'll have to explain it in a roundabout way. Tell me, how does a person think?"

"Think? Why . . . well . . . by logic. He follows a logical track —"

"Exactly! A track. He thinks in chains of logic, if under that we include everything from math to emotional experience. Premise to conclusion. One thing leads to another, one at a time.

"Physics and math have been able to make their great strides because they deal, actually, with the simplest concepts, which are artificially simplified still further. Newton's three laws of motion, for instance, assume that no force beyond the one set being considered is acting on a body in question; and the members of this set can be considered one at a time. We never really observe that. There is always friction, gravitation, or some other disturbing influence. Even in space there are externals. What saves physics is that these externals are usually negligibly small.

"Take a particular case. You

know the two-body problem in astronomy? Given two bodies of known mass and distance from each other, and the laws of motion and gravitation, to find their position at any past or future time. Well, it's mathematically simple. It was solved a long time ago, because there are only two interacting bodies. But the three-body problem is quite another story. Right away, with three interactions, it becomes so complex that as far as I know there's never been any general solution, and only a few special ones. As for the *n*-body problem—!

"Now in the biological sciences, including psychology and sociology, you can't simplify. You have to consider the whole. A living organism is an incredibly complex set of interactions, beginning, probably, on the subatomic level and going on up to the universal environment, from which the organism cannot be separated either, acting on and being acted on by that all the time. You *can't* apply our single-track analysis methods to such a case. The result is, of course, that those sciences are almost purely empirical, sociology hardly deserving the name. If, to use an illustration that's been used before, I want to tackle the three-body problem, I can and will start with the special case where one of them has zero mass. But suppose I were making an analysis of the influence of Pan-Asiatic policies on American domestic affairs before the war. I could certainly not ignore the converse case, or the existence of other countries, I'd have to consider them all at once —which no existing math can do. Any results I got would be qualitative, nonmathematical, inexact."

"I think I see," nodded Boyd. "Of course, people can think of two or more things at once."

"That's different," said Karen. "That's a case of divided attention, each branch of the mind following its single track. It's normal enough, though carried to extremes it becomes schizophrenia."

"You get what I'm driving at," went on Wayne. "Our subhuman and human ancestors didn't need to see the world as a whole. They were only concerned with their immediate surroundings and events. So we never evolved the ability to consider an entire entity. Alaric is a mutant—"

"Some different brain structure," said Karen quietly. "The reversed internal organs may or may not be a linked characteristic. The X-rays showed no brain difference. They hardly would, as it's probably a very subtle matter of cellular or colloidal integration."

"Al didn't have to think, in our ordinary sense of the word, of how to make a weapon," added Wayne. "His extensive knowledge of scientific principles and data co-ordinated in his mind to show him that . . . well, if my guess is right, that the colloids of human bodies are resonant to a particular wave form. And at once he knew all the factors he'd need to generate that wave. It wasn't reason, as we reason, though it was thought—to him, thought on a very elementary, almost intuitive

level. Yet he wasn't able to think of telling anybody."

"I see," answered Boyd. "Humans think in chains. *He* thinks in networks."

"Yes, that's about the size of it."

"Do you think . . . we . . . can ever do that?"

"Hm-m-m—I don't know. Since intelligence seems to depend on upbringing among normal humans, whereas genius and feeble-mindedness seem more independent of environment, and are hereditary, one might argue that they are both mutations, in the individual or an ancestor. Some people, such as Nikola Tesla, seem to have had a degree of network-thought ability, and the fact that Al is the son of a mathematician, who does deal with complexities, is suggestive. After all, no observed mutation has ever created a totally new characteristic. It would have to create a whole new set of genes for that. A mutation is a greater or less modification of an existing characteristic.

"The point I'm making is that humans naturally think in straight lines, but some sort of network, total-considering logic has been developed. The semanticists have their nonelementalistic principle. In math, we only add in special cases, the rest of the time we integrate, and we have our generalized calculi of vectors and tensors and the like. *But*—it doesn't come naturally. It's been worked out slowly and painfully, through many centuries. To Al, it's the natural way to think; but, as like most mutations it involves a loss elsewhere. the simple straightforward logic of humans is unnatural to him and since he is just a kid, and probably not a genius anyway—merely an ordinary network thinker—he hasn't seen the principles of that logic, any more than a human his age sees the principle of nonelementalism. I'd say, offhand, that both types of mind can learn the other type of thought, but not comprehend or apply it on its higher levels."

"There's another thing," put in Karen. Her eyes held a light which hadn't been there for a long time. "Rod just said it. Al should be able, with the proper training, to learn logic, at least enough to understand and communicate. His kind of thought is not adapted to the simple problems of life, but he can be taught to handle those, as we teach human children to think in terms of abstractions. Maybe . . . maybe, then, he can teach us something."

Boyd nodded again. "It's certainly worth the attempt," he said. "We have psychiatrists and other specialists at the capital. If we'd known before that you're a mathematician, Wayne, we'd have asked you there, to join the science center with which President Drummond hopes to rebuild our culture on a basis of genuine sanity. Consider yourself invited as of now. And if we and Alaric can come to understand each other—why, Wayne, you may even get your biological and sociological math. Then we may be able to pull ourselves out of this planetary mess."

"I hope so," murmured Wayne.

"I certainly hope so. And thanks, Boyd." He smiled tiredly, crookedly. "By the way, Karen, you have your superman there. The greatest genius, in his way, that the world ever saw—and if he hadn't had some kind of protective civilization to grow up in and, now, to teach him the elements of thought, he'd never have lived. I'm afraid this particular kind of superman just isn't a survivor type."

"No," whispered Karen, "nor human. But he's our son."

THE END.

THE ANALYTICAL LABORATORY

The Lab this month is definitely unusual—notice that the lowest point score is over three, while the highest is less than one full point higher! The Lab attempts to express numerically the general reactions of the readers, but inevitably it fails in one important respect; it can show the relative ratings in any one monthly issue, but can't make any absolute determinations, or compare the stories with stories of other issues. In addition, it's hard to see at a glance what the general feeling of the issue-as-a-whole was.

In this case, nearly all the readers commented that the April issue was unusually good, and that it was hard to choose among the stories. The fact that it was hard to choose, meant, as a corollary, that there would be wide divergence from reader to reader. Every story would be voted first, and, equally, each would get some last-place votes. Result: high point scores with a very narrow spread—all over 3.1 but under 4.1.

Also definitely worthy of note is our new author, H. Beam Piper, who, in a decidedly-fought contest, came out on top with the first story he submitted to Science Fiction. You'll be hearing from him—the guy can write.

In any case the April Issue report stacks up like this:

Place	Story	Author	Points
1.	Time And Time Again	H. Beam Piper	3.11
2.	Answer	Hal Clement	3.14
3.	Home Of The Gods	A. E. Van Vogt	3.57
4.	An Enemy Of Knowledge	A. M. Phillips	3.71
5.	Project	Lewis Padgett	4.07

THE EDITOR.

BRASS TACKS

Gad! Atomic singing commercials. yet!

Dear Mr. Campbell:

The first time I read Astounding was in the summer of '31, when your cover depicted a human head mounted on a contraption of tubings and wheels contemplating vindicatory mayhem, and I have practically grown up with it—the magazine, not the head. I have often promised myself a subscription, but not till now have I realized that to miss another issue because of newsstand shortages would be a serious loss indeed. You, sir, have elevated an ordinary pulp thriller of '31 to an outstanding magazine of science, fiction and otherwise. I don't remember exactly when you came upon the scene, but you have made those who came to scoff remain to read, and ask for more. As a disciple of science fiction from 'way yonder, and with a substantial quota of converts along the line, I point with pride to Astounding, its editorials, authors and readers, and view with alarm the ones who long for the "good old days" of Pirates, ray guns and multi-dimensional monsters—not that I did not enjoy them at the time. But like the movies, science fiction is growing up, with Astounding the most precocious by far.

I'm happy to see the word Astounding fade from the title. The only astounding thing in your magazine is its chronic progress. And the progress of science itself. A few months back we were reading in the "Foundation" stories about the sale of atomic gadgets, and now you publish a price list of atomic isotopes. Your article on fission in the December issue was clear and informative. How soon before we turn on our radio and hear a melodious female trio commercializing on:

"Co 60 hits the spot
Five point three years
That's a lot
Twice as much for thirty-one three
Co 60! Isotope for me!"

Timmins' covers have always been great. I particularly liked his originality in signing them. But your new

man, Alejandro, seems a shade more adapted for your type magazine. More forceful composition and less vivid colors. All the stories in this issue were exceptionally good, with the possible exception of Smith's. Must *he* of all people fall back on space pirates? However, the word "impossible" in the title absolves him from the stigma of the "good old days." He is best in stories like "Blind Time." A question: Is there any reason why A. Bertram Chandler shouldn't give us sequels to his Biblical allegory, "False Dawn"? It was a new slant. And certainly refreshing.

For the Analytical Laboratory:

1. "Metamorphosite."
2. "Time Enough." (Padget always sounds so reasonable.)
3. "Hand of the Gods." (Clane is growing up fast.)
4. "For the Public."
5. "The Impossible Pirate." (I still think it's impossible.)

I suppose no letter to an editor of science fiction is complete without suggestions. After this paean of praise I'm entitled to two, I guess. Namely, longer editorials and an illustrator instead of a cartoonist for the interior. Swenson may be symbolic but hardly artistic. — Don J. Nardizzi, 510 Delaware Avenue, Los Angeles 41, California.

We're glad too!

Dear Mr. Campbell:

Just a short note to congratulate whoever is responsible for getting Cartier back on the ASF art staff. I, and many others I'm sure, have missed the superior illustrations which he used to produce for *Unknown*. Here's hoping we see a lot more of his work in future issues. Now, if you could only bring back Hubert Rogers for the covers, things would start jumping. — Albert A. Betts, 77 Hayden Street, Toronto, Ontario.

Well, we hope Fyfe won't wait that long again. After all, the war delayed a lot of things—

Dear Mr. Campbell:

Timmins is back — after an absence of one month. He has turned out some nice covers in the past but if this one—January issue—is indicative of his future work you'd better keep Alejandro.

Orban is back. And am I glad to see him. He's the best artist you have. His back heavy-ink illustrations seem to me to fit right in with Astounding's atmosphere. Keep him. But don't overwork him.

Cartier is back. Hooray! As an illustrator of weird and fantastic creatures he has no peer. You picked just the right story for him, too. Let's see more of him in the future, and in *Unknown Worlds*, if possible.

Walton is back. Let's see, his last story was "Boomerang," wasn't it. It's been a couple of years, anyway.

Fyfe is back. Although it wasn't anything exceptional I recall his '41 short, "Locked Out," quite vividly. That was about five years ago. At that rate we can be looking for an-

other story from him about 1952-53.

Now for the Analytical Laboratory:

"1. "Tomorrow and Tomorrow," by Lewis Padgett. Padgett's nearly always good.

2. "Command," by Bernard I. Kahn. I don't know why I'm giving this second place. Even the title wasn't original and there was no plot to speak of. But he did handle the technicalities well. He might develop into a swell writer.

3. "Housing Shortage," by Harry Walton. Cartier's pictures helped.

4. "Time to Die," by Murray Leinster. Pleasant to read; hackneyed plot.

5. "Bad Patch," by A. B. Chandler. A theme which can be overdone.

6. "Sinecure 6," by H. B. Fyfe. A pleasant little story.

7. "The Undamned," by G. O. Smith.

All in all there wasn't much in the stories to get excited about.—Arthur Cox, 485½ Hartford Avenue, Los Angeles 13, California.

Kahn is indeed a medical man—and knows ships, if not spaceships, as well.

Dear Campbell:

Thank you for giving us back Edd Cartier and Orban. I trust that in the future we'll see more and more of their work in place of those subhumans you've been harboring for some time. Swenson was, and is, one. His crude work just does NOT belong in ASF!

The main thing that has prompted me to type this letter to you is your announcement of the improvement in ASF due next month. In one of the fan newspapers, FANEWS, which you likely know about, it is predicted to be a return to a larger format, though NOT the extreme large size.

Incidentally, I, for one, *like* the "bedsheet" format! It packs a dignity the smaller formats CAN*NOT*. However, even a format larger than this pocket-book affair, would be an improvement. However, I'll wait and see. In the meantime, thanks for the dandy entertainment you've been handing us.

My line-up of stories in order of favoritism is as follows:

1. "Tomorrow and Tomorrow." (I like Padgett—his sense of humor is biting yet so true!)

2. "Command." (Is this Kahn feller a medical man?)

3. "The Undamned." (Smith usually takes my fancy but this time he dialogued too much and moved too little. The idea seemed to fail to jell, also. I wonder if he had trouble making up his mind what was to happen next?)

4. "Housing Shortage." (It's hard, putting this here, for I'm a "sucker for time stories.)

5. "Sinecure 6." ("Invasion" stories always please me, but this might have been longer.

6. "Time To Die." (Leinster slipped here in my opinion. The writing is good, the idea is good — but somehow it just failed to "click" with

me. Maybe next time I read it I'll go overboard for it. But right now it's Number 6.)—Leslie A. Croutch, Box 121, Parry Sound, Ontario, Canada.

I think she'll like "Fury," by Lawrence O'Donell.

Dear Mr. Campbell:

A pox on those who mourn for the good old days. The stories published in Astounding nine or ten years ago don't compare with those of today, at all. Too many of the old stories were the thud-and-blunder type, while the new ones are really thought-provoking and well written. But please don't get rid of the ASTOUNDING part of the title. For so many years that ASTOUNDING has stood for the best in science-fiction, it would be a pity to see it go. The cover is just right the way it is.

The fanatics for E. E. Smith will probably denounce me as a heretic, but I'd like to nominate for the two best stories published in Astounding, "Judgment Night" and "Final Blackout." They both have a depth, a kind of grandeur, that most stories lack. Everyone was bitter at the Americans when the Lieutenant died, and the speech of the Ancient, at the end of "Judgment Night" was one of the grandest pieces of writing I've been privileged to read. It was probably a much more prophetic vision of the end of mankind, too; not by superhuman mutants, not by an extra-dimensional invasion, but by man, himself. "Judgment Night" is haunting, it has, far more than the Lensman epics or any other, the feeling of great age, of the sweep and awe, of a great stellar civilization; and the solemn tragedy when that ancient civilization falls. C. L. Moore is a master, no less, of science-fiction. Can't we ever have a similar story, or even a sequel? A sequel would be tragic, probably, but all the same I'd like to read it if it was just half as grand as "Judgment Night."

To rate the December stories, I would put "Metamorphosite" first, "Hand of the Gods" second—this is a very good series, by the way—"Time Enough" third, and let "For the Public" and "The Impossible Pirate" tie for last place. "The Impossible Pirate" is a little hacky. Whatever happened to the Venus Equilateral series, with Don and Arden? I miss them.

Aren't you ever going back to the larger size? The only thing wrong with Astounding right now is that it isn't big enough. Now that the war is over, maybe you can go back to large size, and give us seven or eight stories a month, and a bigger letter section—oh joy! I live for the day when Astounding goes weekly.—Margaret McIntyre, Box 192, Isanti, Minnesota.

I'm not committing myself!

Dear Mr. Campbell:

It has been quite some time since any problems of a mathematical nature have appeared in *Brass Tacks*, so here are two of the most elegant yet simple problems that I have ever come across. Let's see how many in-

telligent readers *Astounding* has!

1. Suppose we have a standard checkerboard of 64 squares, but with the squares in two diagonally opposite corners removed. Is it possible to cover the remaining squares, without overlapping, with little rectangles two squares by one? If so, how; if not, why?

2. One of our foremost Mad Scientists has cooked up a machine that manufactures numbered billiard balls. Suppose the machine is set up so as to drop these balls into a little basket, at the side of which a little man — we will call him "Hercules" because, as we shall see, he has to do so much work—stands. Now the fun begins: at one minute to 12 o'clock, balls numbered 1 and 2, weighing 1 pound and ½ pound respectively, fall into the basket. Hercules reaches into the basket and throws out number 1. At ½ minute to 12, balls 3 and 4 weighing ⅓ and ¼ pounds drop in, H. throws out number 2. At ⅓ minute to 12, balls 5 and 6, weighing ⅕ and ⅙ pounds drop in, H. throws out number 3; et cetera.

Question: What is the weight of the balls in the basket at 12 o'clock?

Go ahead, boys, and orchids to those who solve them; they're deceptively tough!—Roland Silver, Standish D-42, Cambridge, Mass.

The final test of a theory is:
Dear John:

Regarding the argument now running on whether a shell turns over if fired straight up, may I add my two centavos worth?

The writer himself, with his own two lily-white hands aided and abetted by a slightly-converted post-hole digger, has dug in the ground five feet deep to exhume test shells that had been fired seven miles into the air and had landed less than five hundred feet from the point of firing. This, I think, is essentially straight up.

When the post-hole digger has followed the little tunnel down to the unruly object at the bottom, it is found to be sitting there at the bottom of its own hole with its little pointed nose looking up at you.

I've been there and I've seen it—and durn it, I got witnesses.—George O. Smith.

Corrections, thank you.
Dear Sir:

In reference to your recent article in Astounding Science Fiction "Bikini A and B," I find your extract from *Science* rather interesting. However, you seem to be misinformed on your source of information concerning the half-lives of the various isotopes. The best figures available are not those of 1941, but the table compiled by Glenn T. Seaborg of the University of California. This table was published in *Reviews of Modern Physics*, Volume 16, No. 1, pp. 1-32, January 1944. Since that time — although too late for use in your article — a list of fission products has been published with a large number of the half-lives that you have listed. This latter article may be found in the November 1946 issue

of *Journal of the American Chemical Society*, pp. 2411.

Below are a few of the half-lives taken from the Seaborg table. Compare them with your values:

Isotope	*Half-life*
S^{35}	87.1 days
Ca^{45}	8.5 days
Zn^{69}	By Isomeric Transition 13.8 hours By β-decay 57 min.
Ga^{72}	14.1 hours
Ge^{71}	By K-capture 11 days By β-decay 40 hours
Br^{82}	34 hours
Rh^{103}	34 hours
$Ag^{108,\ 110}$	225 days (This activity has recently been proven to originate from Ag^{110}.
In^{116}	By Isomeric Transition 48 days By β-decay 72 sec.
Te^{127}	By Isomeric Transition 90 days By β-decay 9.3 hours
Te^{129}	By Isomeric Transition 32 days By β-decay 72 mins.
Te^{131}	By Isomeric Transition 30 hours By β-decay 25 mins.
La^{140}	40 hours
Ce^{141}	30 days
Ce^{143}	36 hours
Pr^{142}	19.3 hours
Pr^{143}	13.5 days
Eu^{154}	5-8 years
Os^{191}	32 hours
Os^{193}	17 days
$Ir^{192,\ 194}$	1.5 min., 19 hrs., 60 days (Unestablished as of 1944.)
Hg^{197}	23 hours
Hg^{203}	51.5 days (Unestablished as of 1944.)
Hg^{205}	5.5 min.
Bi^{210} is RaE	5.0 days (Occurs in nature.)

C^{14} has since been found to have T $\frac{1}{2}$ 24,000 years. In the Seaborg Table there are 5 listings under element 61. Since then it has been determined that 61^{147} has T $\frac{1}{2}$ 3.7 years.

A stable isotope of elements 43, 61, 85 and 87 cannot exist. There is a Ba^{140} listed. T $\frac{1}{2}$ is $\sim$ 300 hours. —Edmund H. Lambert, Jr., 2618 Durant Avenue, Berkeley 4, Calif.

Trouble is, the readers pick 60,000 word novels that can't be used in a practical anthology.

Dear Mr. Campbell:

Have read and enjoyed Astounding Science Fiction for some time now. The stories written by experts in various fields of science have given a little more understanding in present science developments. Keep up the excellent articles in each issue. They often cover new developments before the popular so-called science and mechanics magazines.

Since it seems to be quite the thing at present to print anthologies of science-fiction stories in hard covers, compiled by one or another self-styled expert in the field why not put Astounding Science Fiction in the field also? In the November 1943 issue there is, in my opinion, the ideal set-up for making a sequence of volumes that should be liked by all science-fiction fans. Refer to the Brass Tacks of that issue. One letter printed has the best stories of the previous ten years rated on order of popularity. He based his ratings on the comments in Brass Tacks letters during this period.

There you have it. A selection of the best stories for a period of years as chosen by the readers themselves. Most of them not available except in back-issue files which are almost out of the question for recent fans. It would take several omnibus volumes to print all of them as listed in W. A. Carrither's letter but I for one would want them all even at four or five dollars each. Why not ask your readers their opinion in the next issue and give the idea some serious considerations? — Paul C. Gunn, 536 Franklin Street, Kewanee, Illinois.

We've given you A. M. Phillips, Hubbard has a novel and several shorter pieces coming. DeCamp was in today, and when he finishes a book he's working on will be appearing in our pages. And you've been reading C. L. Moore!

Dear Mr. Campbell:

First I must lament the departure of the rotogravure section, but at the same time console myself with the fact that the overall improvement of the rest of the magazine will compensate for the loss.

The Rogers' cover was definitely appealing. Slightly off register reproduction kept it from being as beautiful as it might otherwise have been but it was still definitely superior to other magazine covers on the newsstand. Incidentally the copy I got at the newsstand had only the bottom staple but my subscription copy had both of them. Back to Rogers again. My preference in his work, in case he is interested, is for his clear cut work of '39 & '40 rather than the coarser paintings he turned out later but I like both types very much.

INTERIOR ARTIST: Cartier is classic: especially for "Tomorrow's Children." Pat Davis looks promising if he can get away from the pen and ink but then I suspect that it will take time for the artistic technique to catch up with the smooth paper. Orban did splendidly for Padgett's serial in the previous issues but his work for Asimov was little short of sabotage due to coarse, even harsh, sketching. He must be tired.

NOW THE STORIES:

"The Equalizer:" Williamson has the gift for good ideas well thought out and excellently presented in an interesting story.

"Tomorrow's Children:" a new writer with a story of doom which, thank God, does consider the fact that as long as there are men who believe in civilization, all is not lost.

"Little Lost Robot:" problem stories continue to fascinate me.

"Child's Play:" had that psychological punch characteristic of the stories in *Unknown Worlds*. (I'm glad that can't happen to me or can it?)

"Turning Point:" I suppose it is only natural that the end of civilization idea should irritate me but why not? Such a thing would end a lot of things we value including our carriers, our science fiction and in many cases our lives. It was a good story however and perhaps a little too realistic in regard to the world today.

(Continued on page 161)

OBEY THAT IMPULSE!

George O. Smith tries egging on an electric fan to make a room-size omelette.

Photographs by George O. Smith

Once upon a time there was an inventor who fastened a propeller blade onto an electric motor and made himself the first electric fan. His second thought, as he stood there in the cooling breeze, was a contemplation of the effects of hurling an egg into the whirling blades. The terrible urge haunted him night and day, and he would come out of a sound sleep, screaming: "No! No! Never!"

The mental strain of self-restraint drove him into a neurosis, and his income suffered so badly that he was forced to market the electric fan, which, of course, people bought quickly as a means of keeping cool in the summer.

But his sale of the fiendish device

has brought countless millions of people into the same maddening line of thought. Men have chewed their fingernails after buying their first electric fan. Other men, mad with frustration, have gone out and immersed themselves in a welter of hard work, inventing atomic bombs, submarines, and radar.

The restraining fear, of course, is that everybody thinks the process would be messy. They envision the walls and ceiling polka-dotted with egg yolk and streamers of white. They also fear that the fan will catch the egg and hurl it back at them.

Frankly, the process *is* messy.

But it is not so messy that you should seek a psychosis of frustration in an effort to avoid the act. The pictures show what happens. They were taken with a high speed Stroboscopic flash lamp that takes the picture at one thirty-thousandth of a second. Several eggs were used to catch the shots shown, which is not a sequence picture of the same egg, but of three different ones.

The egg was hurled into the fan from a distance of about three feet. To make the contact certain, the fan guard was removed—this guard, by the way, was placed on the electric fan by the inventor just to stop the unruly soul who would try to hurl an egg into it!

The eggs, instead of being hurled back at the photographer, camera, and light, went straight out along the plane of the fan rotation, hurling incipient omelette at the ceiling and walls. Since the experiment was conducted in the basement, a bit of work with the garden hose removed the debris. It is suggested that this trick be removed from the living room unless you have a garden hose handy to clean up.

As a final note to hopeful egg-tossers, the large brown eggs make less spectacular omelette than the small white eggs.

THE STORY OF MODULATION

BY C. RUDMORE

Radio waves are unsurpassed as a means of bringing information, true or false, to the private citizen, but it is by the changes in the radiated carrier wave that intelligence is transmitted. These changes constitute modulation, and it is the radio engineer's concern to meet many conflicting requirements in designing modulation systems to satisfy modern communication needs.

About twenty-five years ago a force more powerful than the atom bomb and more far-reaching and subtle than a risque joke entered the affairs of humanity, perhaps never to leave them. Already the pages of history record its potent effects in many places, and it is certain to have a profound influence on the future of individuals and nations alike, yet in even this short space of time it has become so commonplace as to be taken as a matter of course, like sunrise, or a Republican victory in the State of Maine. This force is radio broadcasting, which scatters both true and false information over the planet so lavishly that few human beings are not directly or indirectly affected.

Recently broadcasting celebrated its twenty-fifth anniversary amid a considerable plethora of speechmaking, moralizing, and slightly oversolemn recognition by its leading lights of its own importance. Yet in spite of the sometimes slightly painful familiarity to which it has attained with you and you and Maggie Kumquat down the street—subbing

here for Joe Doakes, who is out sick—few people have any clear idea of the technique and apparatus by which the blessings of Ma Perkins, Gabriel Heatter, singing commercials and the World Series are squirted into their living rooms. Since, for good or ill, this powerful means for the dissemination of ideas bids fair to remain and continue to expand to yet wider usage, it might be well to have a look at the principles by which broadcasting and other radio services convey information from one place to another, and perform hundreds of similar services.

Basically, the energy radiated by a broadcasting station or almost any other radio transmitting equipment consists of an electromagnetic carrier wave which is caused to vary in a way directly related to the information to be conveyed. The process by which the information is impressed on the basic carrier wave is called modulation, and it is accomplished in a number of ingenious ways, each of which has its advantages and disadvantages.

If we draw a graphic representation of a steady carrier wave without modulation, it will look like Fig 1. Here vertical distances represent voltage, and horizontal distances time, and it is easy to see that the voltage changes from instant to instant of time in a very regular way. With most respectable radio transmitters this unmodulated carrier is a practically pure sinusoidal wave, whose positive amplitude of oscillation is represented by the vertical distance A in the drawing. The total amplitude from positive to negative peaks is, of course, twice A. One complete cycle of oscillation takes place each time the voltage rises from the zero line to a positive peak, swoops down to a negative peak, and returns to the zero line, as shown between the dotted lines in the drawing. The number of such cycles which occur in one second of time is called the frequency, represented by the letter F, and of course the time required for one such cycle is the reciprocal of the frequency.

This unmodulated carrier wave conveys no information, except the bare fact that a station is on the air but when we cause some characteristic of the radiated carrier to vary in accordance with the vibrations of a voice or musical instrument, these variations can be recovered from the carrier in a distant receiver and used to reproduce a very good copy of the original performance.

Fig. 1 suggests two features of the carrier which may be varied—the amplitude A and the frequency F. These lead to the most commonly known methods of modulation—namely, amplitude modulation (AM). and frequency modulation (FM). The terms AM and FM have been bandied about so much of late that they have almost become household words. However, like many other things which have become household words, they're not very well understood so we'll just throw in here a graphical illustration of what the terms mean. Fig. 2 shows a typical bit—a very small bit, it is true—of program material

to be transmitted; it is in fact the note A in the transition region between the low and medium registers of a B-flat clarinet. To amplitude modulate the carrier wave of Fig. 1 with the signal wave of Fig. 2, we make the amplitude of the carrier depart from its constant value in accordance with the signal value, as shown in Fig. 3. Note that the amplitude is enhanced when the signal has a large positive value, remains at its unmodulated value when the signal is zero, and is reduced in amplitude when the signal is negative. Note also that the carrier oscillations are much more rapid than those of the signal so that the amplitude does not change much during any one complete oscillation of the carrier. It is this property which enables us to separate the modulating signal from the carrier; the rapid carrier oscillations are so far above the modulating signal in frequency as to cause no interference. In an actual radio message the difference between carrier rate and rate of change of the signal is much greater than we can show here. If the figure were drawn to an exact scale, the carrier oscillations would be so close together that they would blur into an undefined haze, so we have slowed the carrier oscillations in the drawing in order to depict the process in detail.

Fig. 4 shows the result of frequency modulating the carrier wave with our clarinet note. The amplitude now remains constant. Large positive values of the signal wave speed up the frequency of oscillation, zero values of signal leave the frequency unchanged, and a negative values reduce the frequency. The signal variations may now be thought of as represented by the condensations and rarefactions in the wave train. As in the AM case, the signal variations can be recovered if the carrier changes much more rapidly than the signal. We must have a detector which gives a response proportional to the frequency of the carrier instead of the amplitude as in the AM system.

But AM and FM are really only two of a vast number of methods of modulation, some old and some new, some tried and discarded, some just coming into use, and some which have not yet found any application. The first electrical communication system was the telegraph, which in its most elementary form consists of a long piece of wire using the ground for return, a battery, a switch, and a current indicator of some sort. Close the switch and current flows; open the switch and the current stops. The receiver distinguishes only two conditions of the circuit: "on" and "off." To transmit words we must have a code of some sort, such as an individual combination of short and long durations of the "on" condition for each letter of the alphabet—the familiar "da-da-dit-da" of wireless telegraphy. This is the crude ancestor of what is now called "pulse length modulation" (PLM), which does not stick to just "short" and "long" pulse, but uses a continuous range of pulse lengths capable of repre-

senting speech or music directly without any code. The duration is not the only property of a pulse which can be varied to represent a signal; we also have "pulse position modulation" (PPM), also called "pulse time modulation" (PTM) and "pulse delay modulation", in which the position of the pulses with respect to equally spaced reference times are varied in accordance with the signal. There is also "pulse amplitude modulation" (PAM) in which the height of the pulses is changed; "pulse frequency modulation (PFM), in which the number of pulses sent in unit time follows the signal; and still other methods of pulse modulation not yet emerged from the laboratories where the search for new and better methods is unceasing.

Getting back to the original telegraph code, it's obvious that spelling out words by dots and dashes is a relatively slow method of communication, faster it is true than sending a letter by mail, but not nearly as quick as face-to-face speech. The speed is about right for a telegraph system, however, which just can't handle things which go much faster. One reason for this is that a long telegraph wire has quite a bit of electrical resistance shunted by capacitance to ground. Every time the sending key is closed or opened a lot of time is consumed in charging or discharging what is in effect a string of shunt condensers with series resistors in their leads before the result of the change finally gets to the other end. Another reason is that telegraph signals are sent by a hand operated key or some kind of rotating machine with sliding contacts, and there are definite physical limits on the possible speeds of operation in either case.

When the possibility of sending signals through space by radio was discovered, it was natural at first to graft the old wire telegraph tricks onto the new art. The early radio transmitters used a spark coil to excite the antenna. Each spark set off a train of damped waves with frequency determined by the tuning of the antenna. Ship's Radio Officers are called "Sparks" to this day. The sparks of the old transmitters were generated at a steady rate by an automatic make-and-break device in the primary of the spark coil. By opening and closing a key in series with the antenna the operator could start or stop the resulting radio waves and thus produce dots and dashes. This again was two-valued pulse length modulation, but with a new twist; instead of sending the pulses of direct current from a battery into a wire line, spurts of radio energy were being sent into space. In modern pulse modulation radio systems it has been found convenient to use two sets of classificatory symbols—the first one defining the type of pulse we are using to represent the signal, and the second, the kind of modulation by which we are sending the pulses over the radio path. In modern notation, early wireless telegraphy was PLM-AM; that is the pulses were modulated in length and transmitted by amplitude modulated radio

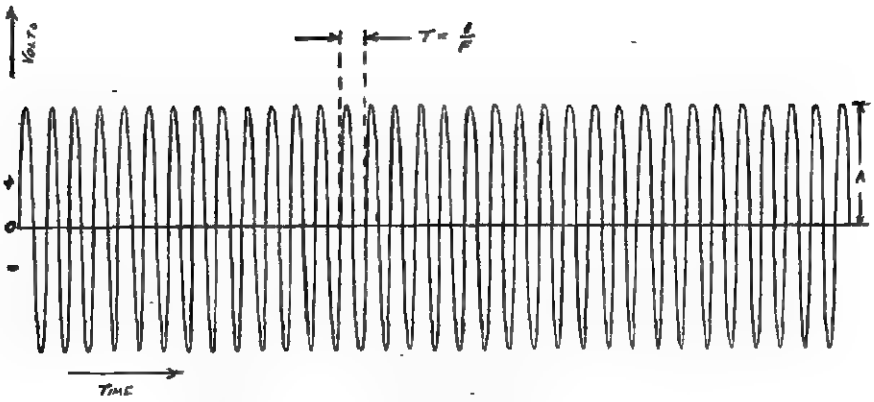


FIG. 1 UNMODULATED CARRIER WAVE

Jack Benny fiddles while George-Burns, but neither of them would fracture the quiet of your living room without the aid of modulation equipment—and the ingenious brains that devised it. An unmodulated carrier wave conveys very little information, except that the transmitter exists. One or more of its properties such as frequency, amplitude, direction, or angle of polarization must be varied in accordance with the program material to make it really useful.

waves. To be sure only two pulse lengths were used—short and long; and only two amplitudes of radio wave—full strength and zero; but the essential principles were there.

In fact, the early radio men actually experimented with still other forms of modulation which have become more famous in recent years. While simple on-and-off keying was adequate for operation of a spark transmitter, the spark transmitter was itself an unsatisfactory generator of radio waves because of the high damping, or rate of decay of the train of waves it generated. The spark was produced by breaking a high current circuit in the primary of a coil. Enough voltage was thus built up across a pair of terminals in the secondary to break down the air gap between them and form a spark. The resistance of the spark gap remained fairly high, however, and tended to make the oscillations become progressively weaker in the time interval between successive gap breakdowns in the same way that friction damps out the oscillations of a weight hanging on a spring. An improvement worked out by Poulsen made use of an electric arc instead of a spark. Undamped radio waves were thus introduced. Poulsen's transmitter could not be keyed like a spark set, since an arc is started by bringing the electrodes together to get the current flowing and then pulling them apart to draw the arc out to the proper length, usually much greater than the gap

separation in a spark set. An early method of sending used a short circuiting switch around several turns of wire in the antenna tuning coil. With the switch closed the antenna was actually tuned to a different frequency and a corresponding change in the frequency of the transmitted wave occurred. The method of operation then was to have the receiver tuned to the frequency radiated when the switch was open. When the switch was closed the radiated frequency shifted, the receiver was no longer in tune with it, and very little or nothing was received. As far as the operators were concerned the same old dots and dashes were being used, but a new radio principle had been introduced—none other than frequency modulation of which we have heard more in recent years. In our classification of radio pulse modulation methods, the arc transmitter was a PLM-FM system, although only two pulse lengths and two frequencies were used. To add to the completeness of our historical survey we should mention that ways of modulating the amplitude of arc transmitters were also found, but these methods are of less interest here since they do not belong to species of modulation different from those already mentioned.

The transition from wireless telegraphy to wireless telephony, which is the technique of regular broadcasting, became more practicable with the invention of the three element vacuum tube by De Forrest. This Protean device was incomparably more flexible than previous means for generating carrier waves, and made possible practicable systems of smoothly and continuously varying the *amplitude* of the carrier as well. The radio carrier wave did not suffer from the slowing down effect of long wire lines because it does not have the electrical inertia of the wire system which makes necessary special amplifying and correcting equipment about every ten to fifty miles in even land telephone systems. These two factors soon made possible long distance communication across oceans by voice instead of Morse code, a thing that had been impossible with ocean cables because of the impossibility of installing the necessary repeater stations every few miles along the sea bottom. Early efforts to voice modulate spark and arc transmitters had been only moderately successful because the lack of amplifying devices made it necessary to put the microphone directly in series with the antenna. So installed, the "mike" could and sometimes did reach out and bite, hard.

With the development of the three electrode vacuum tube, a Gargantuan revolution occurred in the radio art. The things which had been hard to do before now became simple. By means of amplifiers constructed from the tubes, microwatts of microphone power were made to control kilowatts in the transmitter output. By feeding back plate output to the control grid in the proper direction, it was found possible to produce a stable generator of self-excited undamped oscillations deriving the required energy from the

plate battery, and with frequency controlled by a tuning coil and condenser—the "tank" circuit. Not only could large amounts of modulated power be radiated, but high gain receiving amplifiers could bring exceedingly weak waves up to audibility. Also the vacuum tube was found to modulate when speech and high level carrier were simultaneously impressed upon it, giving out the form of wave illustrated in Fig. 3. The modulating property depends on the change of resistance of the plate circuit which occurs when the plate current swings over a wide range. We may think of the speech signal being faced with a rapidly varying conductance determined by the carrier wave, so that the two waves are effectively multiplied together in the output.

Thus amplitude modulation came into being as the method to be used in radio telephony. It held undisputed ascendancy for about two decades during which commercial radio broadcasting was established and nurtured into a major industry. Universal use of AM was warranted during this period because it fitted the techniques as then known—it was AM or nothing. It was not a matter of being able to build a satisfactory modulator, but a question of how much frequency range was needed, for the number of kilocycles available was severely limited in those days.

It was not that the "ether," or whatever we like to call the space between transmitter and receiver over which radio waves are propagated, is a sluggish medium like an underground or underwater cable. The ether is capable of transmitting waves over practically an unlimited frequency range, all traveling with the enormous velocity of light—(186,000 miles per second)—and with no one frequency favored more or less than any other as far as attenuation of its amplitude is concerned. The bottleneck is in the transmitter and receiver. The tuned circuits of the transmitter must respond with sufficient rapidity to enable program variations to get out on the ether, and likewise the tuned circuits of the receiver must react fast enough to let the changing radio wave come in. Furthermore we want to make room for more than one station to be on the air at the same time, so we have to slice up the available frequency range into channels, and tune the channels sharply enough to keep them from cross-talking into each other. Sharp tuning is another way of saying poorer response to fast changes.

Some arguments carried on during these times help to illustrate the problems involved. A group of engineers interested in the development of the so-called "Stenode Radiostat" argued that we did not have to use a band of frequencies in AM since we only had to transmit a constant frequency wave with varying amplitude. They recommended insertion of a needle-sharp quartz crystal transmitting filter which in effect passed only one frequency—the resonant frequency of the crystal, and argued that changes

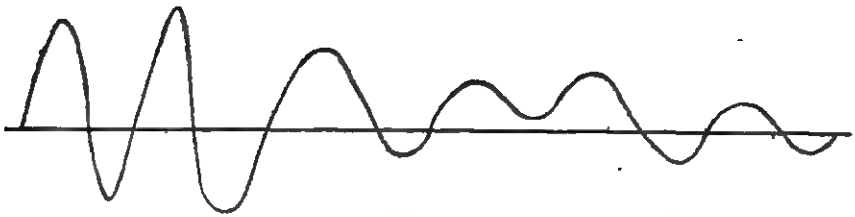


FIG. 2. OSCILLOGRAM OF CLARINET NOTE

Like most musical instruments, the clarinet produces a sound rich in harmonics, or overtones, as the musician calls them. The note A sounded by a B flat clarinet in its lower middle register looks like this on the oscillograph record. For many purposes modulators must be capable of impressing faithfully on the carrier wave even the fifth and sixth harmonics of the lower tones.

of amplitude in this fixed carrier would get through the filter. True, they would, if we waited long enough after the change was made, but the essence of program transmission is time. The radiated wave must follow the program right away because something else is coming along a few milliseconds later and we cannot tolerate much mixing up of program sequences. The Stenode tried to dodge the issue by an equalizing network in the receiver which favored frequencies remote from the carrier and thereby made the receiver respond faster, but this was a virtual admission that other frequencies beside the carrier were necessary. It is one of those grim facts amply demonstrated by both theory and experiment that an amplitude modulated carrier requires a band width both above and below the carrier frequency equal to the band width occupied by the original signal. Whether you call these appendages sidebands or not is a matter of individual whim, but it is futile to deny that there is energy associated with the amplitude modulater carrier in these regions. The skeptic need only try trimming off the sidebands with a sharp filter and see what happens to his reception.

The telephone engineers discovered that they could get along without one of the two sidebands and even without the carrier itself. Transmission by the single sideband suppressed carrier method is the ultra in band width economy; the same band width is used as occupied by the original signal. There is just one hitch—the missing carrier has to be resupplied at the receiver in order to kick the sideband down to the exact original signal range. The local or homodyne car-

rier has to be just about right in frequency; if it is off by say 200 cycles out of say 1,000,000 cycles, which is only 0.02% error, all the frequencies in the recovered signal will be shifted by 200 cycles, and brother, that does not sound good. In commercial telephone circuits such as the transatlantic radiophone operated jointly by the A.T.&T. Co. and the British General Post Office, the Type J (open wire), Type K (cable), and Type L (coaxial) carrier systems of the Bell System, single sideband suppressed carrier is used successfully, but the broadcasting companies rightly do not put the burden on the consumer of generating and maintaining his own carrier. They give you both sidebands and the carrier, using approximately twice as much frequency space per station, but making the receivers much less expensive. Commercial AM broadcasting carrier frequencies are assigned 10 kilocycles apart; The Bell System gets a voice channel for every 4 kilocycles on its carrier systems. Some further reduction could be made with no tremendous degradation of speech quality, but communication engineers have become pretty well reconciled to the fact that the amount of frequency range provided in an AM system definitely puts a ceiling on the quality of reception they can hope to get.

In the early twenties some engineers came forth with a proposal to switch from AM to FM. Their argument was that in FM the amplitude of the carrier is constant and the frequency swings an amount proportional to the voice amplitude. They then reasoned, that if we made the peak speech wave produce a shift of say 100 cycles above and below the unmodulated carrier frequency, we only need a band 200 cycles wide regardless of the frequency of the speech. The reader may recognize a curious similarity between this argument and that of the Stenode Radiostat. Interchanging the words amplitude and frequency in the two cases brings out the parallel. One argument says that we can send a constant frequency with a variable amplitude through a system which can accommodate amplitude variation but not frequency change; the other says we can send a constant amplitude and a variable frequency through a system which can handle the required frequency shift but not variable amplitude. Both are wrong for the same reason; they do not take into account how fast changes must occur. The hypothetical 200-cycle band would allow the frequency to change by 200 cycles all right if we did not try to perform the change more than roughly 200 times per second; if we tried to change the frequency through the 200 cycle range 3,000 times per second, the output wave would become a hopeless jumble of sluggish drawn out attempts to follow the too-fast input. The use of FM to save frequency space was thoroughly disproved theoretically and experimentally, and FM was practically not heard of again until the late thirties, at which time it

gradually began to dawn on the communication world that another revolution—comparable to the introduction of the vacuum tube—had occurred.

The new revolution was the opening up of the high frequency (short wave) radio spectrum to practical use. The significance of this may be made clear by a few numerical examples. The commercial AM broadcasting range extends from about 500 to 1600 kilocycles per second. (Kilo=thousand.) In this range it is feasible to separate stations about 10 kilocycles apart by ordinary tuning methods, and we have noted that this is about the band width needed for satisfactory quality radio programs when the double sideband transmitted carrier method is used. It is true that the perfectionist would prefer a wider band, but he is not very articulate about his desires. The soap opera addict, who writes most of the fan mail, would not find any advantage therefrom. We thus see that commercial AM does a pretty good job carving up the available frequency bands in accordance with the demands of the customer.

When we consider the higher frequencies, the situation changes. The selectivity of a tuned circuit in general operates on a percentage basis. A 10-kilocycle separation at 1000 kilocycles amounts to 1% of the channel frequency. One percent of a channel frequency of 100 megacycles is 1 megacycle or 1000 kilocycles. Roughly then it is about as hard to separate channels 1000 kilocycles apart at 100 megacycles as to separate channels 10 kilocycles apart at 1000 kilocycles. To separate channels 10 kilocycles apart at 100 megacycles would be beyond practical attainment with tuning procedures in use on present day commercial radio sets. The conclusion is that at the high frequencies large blocks of frequency range are crying to be used and AM is not able to get any more good from them than if they were narrow.

And now we come to Armstrong's discovery that FM offers a means of obtaining an advantage by using a large frequency range for one channel. In FM the amount of recovered signal increases with the extent of the frequency swing, so that widening the frequency deviation has the same effect as raising the transmitted amplitude of signal. We thus have two ways of boosting the level of a radio program above static and other noise in FM—we can either increase the power in the transmitter or increase the frequency swing. In the short-wave region, the frequency range is there for the using so we can reduce the power requirements as compared to AM. For example a first class AM broadcaster may use a 50- or 100-kw. transmitter and a band width of 10 kc. An FM broadcaster of comparable rank might use one or two kilowatts and 200 kc. of band width. The actual quality of reception in the local area from the FM station would be better than from the AM station for several reasons.

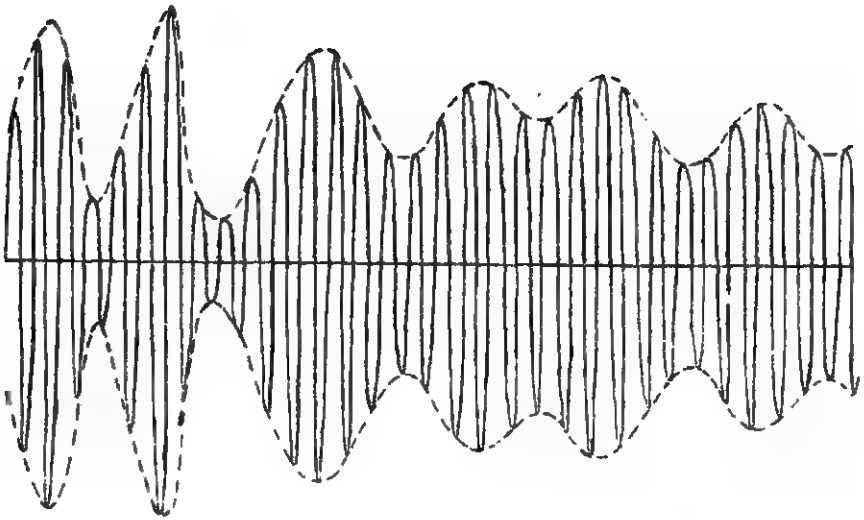


FIG. 3 AMPLITUDE MODULATED CARRIER

Amplitude modulating the RF carrier wave with our note A from the B flat clarinet causes the oscillograph record of the carrier to appear as the composite of the two waves. For clarity the two waves have been drawn to differing time scales. On the same scale the individual oscillations of the RF carrier would be crowded so close together as to be an indistinguishable blur.

First, a wider band of audio frequencies can be used in the FM case—say 15 kc. instead of 5 kc. If the FM broadcaster is splurging to the tune of 200 kc. swing, an extra 20 for his audio is picayune. The AM broadcaster can not conveniently widen his band because he is hemmed in by assignments to other channels flanking him. If he were working with short waves instead of the long wave commercial AM broadcast type, he also could use a wide audio band, but there is, of course, too much commercial investment in the present AM transmitters and receivers to make such a change overnight, even supposing that the unseen audience would approve of the desirability.

A second reason the FM reception would be better is that it is technically a more feasible matter to frequency modulate a transmitter with high fidelity than it is to do a similar job with AM. Part of the difficulty is the large amount of power which has to be controlled in the AM case. The frequency modulation can be done at low levels and the FM wave amplified to high level by amplifiers which would

not be good enough for a corresponding AM job. An FM amplifier can overload badly without producing any distortion if the spacing between zero values is preserved.

A third reason which is not stressed very much by FM advocates is that there is not as much static interference in the short wave bands as there is in the long wave bands. This might lead one to think that AM broadcasting without static could be achieved by switching to the short waves. Probably much could be done in this direction, but the sad fact is that it has not been done and probably won't be. It appears that FM will win here because it is easier to override the noise with frequency swing than with power. There are other sources of noise beside static, for example, interference from other stations, automobile ignition systems, and diathermy machines. Wide-swing FM is particularly immune to most of these disturbances because a frequency detector follows the frequency of the largest component present, which is usually the wanted signal. The effect of disturbances of smaller amplitude than the signal from the desired station is to produce beat frequencies between the frequency of the disturbance and that of the station. Since the latter is swinging rapidly over a wide range, the beat or difference frequency is usually beyond the range of audibility and is not passed to any appreciable extent by the 15 kc. audio band of the receiver output. Ignition noise consists of sharp peaks which may be much higher than the wanted FM signal but which are confined to such short time intervals that the effect is not noticed. This behavior is different from that of narrow band circuits in which short sharp peaks are smeared into disturbances of smaller amplitude and longer duration thereby causing trouble. An interfering FM station which produces a higher amplitude than the wanted signal may, of course, take over control and force us to listen to its program. Also if we widen our frequency swing indefinitely and thereby expose the wanted carrier to a wider and wider band containing more interfering components, all the interference may sum up to large peaks exceeding the amplitude of the carrier and causing the detector to respond to the frequency of the interference instead of the carrier. Under such conditions FM works in reverse, suppressing the wanted signal and letting us listen to the noise. This phenomenon, called cracking or breaking the limiter, puts a ceiling on the amount of frequency swing we can use with any fixed amount of power.

The very high frequencies assigned to FM, and its ability to override interference enables a different allocation of channels as compared to AM. The same wave lengths can be assigned to different stations with moderate geographical separation, and the receiver will pick up the biggest signal in its locality without being bothered by the smaller ones. The short waves used in FM do not travel

much beyond the horizon so that the areas served are fairly distinct. Similar allocations in long wave AM would lead to myriad whistles and crosstalk even when the distance between stations is great. This is the reason that "cleared channels" are provided for some of the biggest AM stations. To be fair we should mention that in FM the fellow on the boundary fringe separating the regions served by two stations has a tough time. His receiver may jump back and forth from one station to the other under control of the vagaries of loss variation of the two paths. He would probably vote for cleared FM channels, but would also likely find himself in the minority.

We have been talking about FM as associated with the short waves or high frequencies, which permit enough band width to be used in one channel to bring out the advantages of FM. By "high frequency" we mean here frequencies up to 100 megacycles or so, which a few years ago were regarded as high. Now, of course, the useful radio frequencies have been pushed far beyond this range. We have gone through the extension to "very high frequencies" (VHF) and "ultra high frequencies" (UHF) to what are now known as microwaves. Other transitory classifications which should perhaps be mentioned are VHFI (Very High Frequency. Indeed!) and JWHF (Jove, What a High Frequency!). At frequencies of 4000 to 6000 mc. in the heart of the microwave zone, squanderings of band width such as never dreamed of in FM are possible.

The answer to the challenge of increasingly enormous available band width has been the various forms of pulse modulation. We mentioned these before in relation to the telegraph. Modern pulse modulation consists of the application of ancient telegraph methods to speech by speeding up the processes involved. The secret of the speed-up is to replace cumbersome switches by high speed inertialess electronic equivalents. With vacuum tube switches we can send pulses so fast that we would have time left on our hands if we only sent one program over the channel. so we rig up an electronic commutator which sends a whole group of programs in turn from the same radio station. The problem of talking on pulses is worth an entire article of its own, and we shall only state here that the possibility of "time division multiplex" in radio which pulses offer in contrast to the frequency discrimination method of separating channels used in AM and FM is one bound to have profound influence on the radio art. Time division is really the older of the two methods since it has long been used in telegraphy to enable a fast cable to handle traffic from a number of slow operators. Its revival for telephony has only been possible in recent years because of advancements in electronic tubes and associated circuits as well as the opening up of higher frequency radio bands.

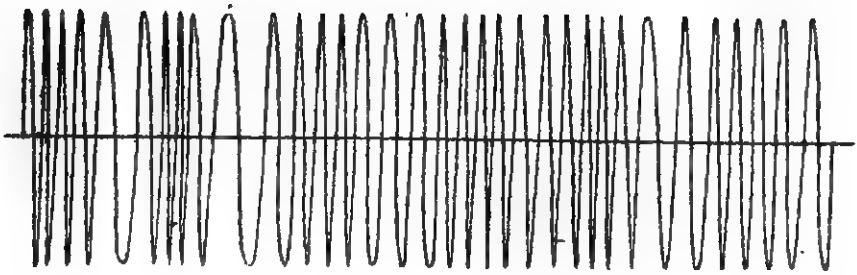


FIG. 4 FREQUENCY MODULATED CARRIER

Frequency modulation leaves the peak-to-peak amplitude of the carrier wave constant, but causes the time of arrival of successive wave fronts to vary, as shown. Since most random atmospheric noise and man-made interference from shavers, neon signs and other devices is essentially amplitude modulated, FM receivers can be made to discriminate strongly against it, yet still respond well to the carrier frequency changes, hence the "noise-free" effect.

It appears natural to ask at this point what other conceivable methods of modulation are there and what uses might they have? One which comes to mind is modulation of the polarization plane. It is known that radio waves are transverse vibrations, and it is known how to design antennas which produce polarized vibrations, i.e., vibrations confined to one plane. Similar receiving antennas can be designed to give maximum response to vibrations in one plane. By using two transmitting antennas which polarize at right angles to each other and varying the relative strength of the carriers supplied to each, we could shift the resultant plane of polarization of the combined wave continuously. The output would be a polarization plane modulated wave. We are now beginning to run out of abbreviations as PPM has already been used for pulse position modulation. We shall call this one PM, emphasizing that we do not mean phase modulation, which is merely a particular kind of pre-emphasized FM. The output of a receiver with antenna designed to favor a particular polarization plane would give a response varying with the polarization plane of the incoming wave and hence would serve as a converter of PM to AM. We note that it would be theoretically possible to send three simultaneous messages on one wave length by using AM, FM, and PM, provided that a true polarization detector could

be realized, one which gives a response proportional to the polarization angle and independent of amplitude and frequency. However, this is not the best possible result, for by using AM and FM on each of two waves polarized at right angles to each other, we could get four independent channels.

The principal difficulty with PM is that the polarization plane is not likely to stay put during transmission. Reflections from objects and nonuniform layers of air would be sure to cause confusion. Even in wave guides where conditions are presumably under control, it is difficult to make the transmission path smooth enough to preserve a particular orientation of the polarization plane for any great distance. However, that may be just a deficiency of present day techniques which could be remedied over night by an appropriate new discovery, although this seems unlikely.

Of course there are other properties of the radiated wave which might be varied by our modulating system to convey intelligence. For instance, a sharply directed beam of radiated energy might be caused to vary its direction with the applied signal, and thus produce a varying output in a distant receiver. Actually such a system would be useful only with receivers aligned along the center line of the radiation of the carrier in the zero modulating signal position, and this would so confine its utility as to make it impracticable, particularly when the matter of interference with receivers tuned to other services is considered. Also, the center line of radiation of a directional antenna often shows severe changes with changing weather conditions because of variations of the reflecting quality of the ground in the radiation field.

Another property possessed by a radio wave is its velocity of propagation. We might ask then why not velocity modulation (VM)? Well, the velocity of a radio wave in free space is equal to that of light and so far as we know is one of the most invariant things in the universe. We might control the velocity in a wave guide by filling the guide with some substance which slowed down the speed of the waves but to change the velocity rapidly by such a mechanical means would hardly seem attractive. Velocity modulation has found important applications in the communication art but not as far as the velocity of radio waves is concerned. VM has been applied to reproduction of a television image. The original method was to spray the field with a uniformly moving beam of light or stream of electrons with intensity varying with the brightness of the corresponding point in the original subject. In velocity modulation, the intensity of the light or electron beam remains constant and the speed of motion varies inversely with the brightness. The dark places become so because the beam does not linger there and the light places are illuminated more because the beam hangs around longer. The practice did not come into general favor, and as far as

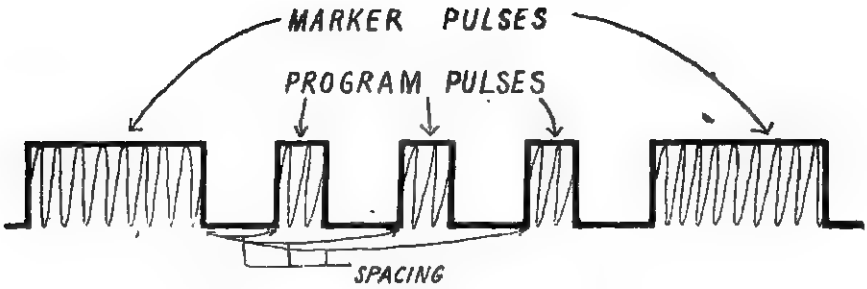


FIG. 5

PULSE TIME MODULATION

Intelligence can also be conveyed by transmitting the carrier only as a series of short pulses, which are varied in spacing or amplitude in accordance with the program material. Pulse time modulation depends on varying the time spacing between a marker pulse and a program pulse or pulses. Band width requirements restrict its practical use to fairly high frequencies only recently opened to use.

present day television is concerned it is just another method that we could use if there were any particular advantages in it.

In very high frequency electron tubes, however, VM has become a really important technique. Here the velocity of a stream of electrons is controlled by a variable accelerating potential. The process has useful significance only when the transit time of an electron through the tube is comparable with the period of oscillation of the electrical wave traversing the tube—in other words at very high frequencies. Velocity modulated tubes are called klystrons, rhumbatrons, or more humbly "velocity variation" tubes. It is possible to use them as high frequency oscillators, amplifiers, and either amplitude or frequency modulators. Since the effect of velocity modulating an electron stream is to produce layers of varying density of electrons, "density modulation" might be an equally good name for the process.

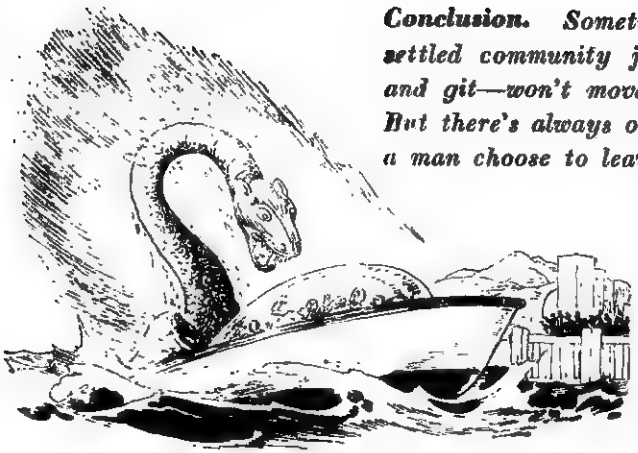
It should be clear by this time that the number of possible kinds of modulation is very great indeed, and it would be a rash individual who would claim to enumerate them all. Those mentioned so far have been within or at least not too far from the edge of the realm of practical usefulness. If we were to speculate on more dubious things which there would not appear to be much point in studying, we could rack up quite a few more. To go back into antiquity for a moment, one might vary the rate of decay of the damped oscillations from a spark transmitter, thereby producing "damping modulation." Most of the radio waves we have talked

about are nearly plane waves, but over short distances we could make use of spherical waves. The curvature of the wave front is then a property which might be modulated. Changing the curvature is equivalent to changing the radius of the sphere defining the wave front which is in turn equivalent to changing the distance from the source. Curvature modulation thus appears to be a variation of the Doppler effect associated with wave propagation from a moving source. Doppler modulators have not come into any considerable use because of the familiar difficulty of speeding up mechanical motion to the necessary extent. It does, however, enter the picture as a source of unwanted distortion in loudspeakers. If the speaker cone is pumping out a strong low note and a high-pitched tone at the same time, the to-and-fro motion of the whole cone alternately makes the source of the high frequency sound approach and recede from the listener's ear at speeds dependent on the frequency and amplitude of the low note. Doppler effect causes the high note to apparently rise and fall in pitch in a sort of "warble" effect, in step with the pulsation of the low note. To minimize this and certain other effects speakers are often made in two parts, one carrying only low, and the other only high pitched sounds, with a dividing point somewhere between 500 and 2000 cycles per second.

This last item touches off some thoughts about the various unwanted kinds of modulation which design engineers try their level best to minimize or eliminate. Notable among these is a form of distortion of the amplified wave output of a vacuum tube known as tube distortion. This results from the fact that even the best vacuum tubes do not quite reproduce in their output an exact copy of the signal put in. Elaborate methods, particularly the use of negative feedback, are used to reduce such distortion to a minimum, and it is possible to keep the percentage of such unwanted distortion to such a low value that it is undetectable by the ear.

We could continue here into various unwanted kinds of modulation which are introduced mechanically in recording and playback systems by such things as turntables which do not turn at constant speed, or records pressed off center during manufacture, but to do so several more articles such as this one would be required. Suffice it to say that really good design and manufacture can minimize such effects to negligible proportions when they are not wanted, although it must be admitted that at present the ideal is rather far removed from current commercial practice. And even when all such unwanted modulation is eliminated, there remains the often unpleasant wave form of the original sound which too often comes from a source less free of unpleasing vibrations than a Crosby or a Stafford. Needless to say, the engineer can do little to improve performance in this field.

THE END.



Conclusion. *Sometimes an old and settled community just won't git up and git—won't move to a new home. But there's always one way of making a man choose to leave his old home—*

FURY

BY LAWRENCE O'DONNELL

Illustrated by Orban

Sam Harker was born six hundred years after the Earth's destruction by an atomic chain reaction. Man didn't die when Earth did. There were survivors, and they fled to Venus—which was uninhabitable. The cataclysmic fury of semi-Jurassic, nonterrestrial flora and fauna forced the race to retreat to the great impervium domes that were constructed on the seabottoms—the Keeps. There mankind lived—and slowly began to die.

Atomics had changed the race. The majority were short-boned, heavy and fleshy. But there was a sprinkling of mutants, Immortals as they were called—the powerful Families of the Keeps who had a life-expectancy of more than seven hundred years. Physically they were variants from the norm; they were long-boned, lean, tall, unmistakably Immortals.

Last of the great Harker Family was Blaze Harker. His wife should have known better than to have a child; she was not built for childbearing. She died when Sam Harker was born. And Blaze, blindly, insanely hating his son for that reason, took revenge. The Keeps had their underworlds and their darker technologies. When Blaze's father, Zachariah Harker, and his grandfather and great-grandfather tried to locate the boy, they failed. Blaze would not tell them what he had done, and the Harker heir, with his heritage of nominal immortality—was gone.

An underworld technician, well paid by Blaze, worked on Sam. Endocrine surgery. The baby's physical pattern was altered. He was made hairless, and, when he grew larger, he would be short-boned, heavy, and fleshy. He would not know his real name. He would be Sam Reed.

He grew up in the Keep underworlds, learning the underworld codes. The Slider tutored him, a fat

old Chiron-Fagin wise in his sinful ways. Sam Reed learned.

Love between Immortals has many facets. Zachariah Harker, Sam's grandfather, and Kedre Walton took long vacations from their love, but inevitably they swung together again. Until, when Sam was forty, Kedre saw him at Keep Carnival, and was drawn to him by some quality she could not analyze. Perhaps she sensed that he was an Immortal, though she did not know it, and neither did Sam, who was simply a racketeer, promoter, and operator of whatever seemed most profitable.

He wasn't apparently impressed by an Immortal's favors. He was willing, but not eager. For Sam had been a have-not all his life, and automatically he resented the Immortals—Zachariah, too, when he met him, though he undertook a certain commission Zachariah offered him.

There were two reasons Zachariah made this offer. Kedre was too interested in Sam, and Sam could be got rid of fairly easily after he had fulfilled his task and killed Robin Hale. Hale was a nuisance. He was organizing a plan to colonize the lands of Venus, and the Families felt that such an attempt would not only be bound to failure at this time, but it would weaken the Keeps for future attempts. Hale was a malcontent. An Immortal, he had been a member of one of the Free Companies that had existed for centuries on Venus, hired mercenaries subsidized by the Keeps to fight their wars for them without running risks themselves. The Companies were gone now, but Hale lived on, a purposeless adventurer. He found his purpose when he visited the Temple of Truth and met the Logician, the oracle everyone thought was a thinking-machine.

The Logician, as Hale learned, was simply an Immortal with a curious talent—he knew all the right answers. It wasn't prescience; it was simply a talent for truth. He advised Hale to colonize landside.

Instead of killing the Free Companion, Sam joined forces with Hale. He saw his opportunity. He was a crook and a promoter. He convinced Hale that he could promote the Colony venture, in the face of the Families' opposition. By propaganda and publicity, Sam succeeded. The people of the Keeps rose to the glamorous bait of landside colonization. The funds began to pour in.

Sam quietly sold three hundred percent of the stock. It would make his fortune—if the Colony failed. It couldn't succeed, he knew—landside was uninhabitable.

Rosathe, a Keep dancer, dropped into his arms with other triumphs. He had wanted her for a long time. Now he had her, and he was winning his fight against the strangely passive Immortals—proving that he, a short-termer, was as good as they were—

Then Kedre and Zachariah struck, using Rosathe as their tool. Sam did not know what had happened until he smelled the terrifying scent of the dream-dust Rosathe puffed into his nostrils. And after that he woke, quite suddenly, in a Keep

alley. Dream-dust could put a man to sleep for a long time.

How long?

A passer-by gave him the answer. "The Colony? Oh, the Land Colony! You're a little late. It's been open a long time now—what's left of it."

"How long? How long?"

Sam heard the answer, and found himself hanging on the bar of a vending machine and looking at his face in the mirror. His face hadn't aged. Not a bit. And that was impossible.

Because he had been drugged—under dream-dust—for forty years.

The great public libraries gave him information, but the vital point he already knew: he was immortal. But that was his only asset. He had to cure himself of the dream-dust addiction, and that required money. His own credit was useless. The library records said that the Colony bubble had burst forty years ago, when Sam Reed dream-dusted and his swindle came to light. His name was worse than useless.

But he still had Sam Reed's experiences to draw from, his shrewdness and his knowledge of confidence tricks. So he was able to swindle a gambler who had been a raw kid when Sam dream-dusted, and then he had collateral—the radioelement korium, hard to dispose of, but valuable.

The Slider was still alive, sunk in dreams induced by the murderous Orange Devil drug, and the Slider still had his connections. He was willing to act as Sam's agent in certain matters. And, delving in his memory, he was able to give Sam enough clues to explain why Sam had the short, thick body of a non-Immortal. Somebody, Sam deduced, had paid that outlaw medic to operate on his newborn body.

New mysteries appeared. When he went to the hospital to undergo the dream-dust cure, he learned that he had been discharged as cured early that same morning. Somebody had kept him alive for forty years, somebody had had him cured, somebody had used an amnesic drug on him—why?

His first step toward finding out was to disguise himself as his own imaginary son, Joel Reed. In that guise, he saw Robin Hale, now Governor of the Colony—what was left of it. After the bubble had collapsed forty years ago, Hale had gone stubbornly ahead, in spite of the Immortals' opposition. He had started the Colony. Then the Immortals hadn't dared let it fail, but they used legal trickery to gain control and keep it at status quo. *Hale was a figurehead now. So he was willing to join the bogus Joel Reed in a new venture. "Joel" had, presumably, inherited a forty-year-old patent from his father that opened a huge area for new colonization.*

The pair started propaganda in the Keeps, aimed at subsidizing Plymouth Colony, which would start at the end of an archipelago and island-hop as the landside flora and fauna were brought under control. They raised some money—not much, but enough to outfit a mobile fleet and start Plymouth.

More korium was needed to keep the venture going. Sam got it by

talking Hale into ordering the fleet to battle stations—over Delaware Keep. He simply pulled a holdup. "Pay a korium ransom," he told the Keep, "or we bomb you!"

It was a bluff and the Harkers knew it was a bluff. But Sam appealed to the people of the Keeps, trying to overthrow Immortal prestige. He did it, partly because he had acquired a film showing Blaze Harker insane, and under restraint. He threatened to exhibit this to the people—and won.

Then Zachariah Harker unmasked "Joel" as Sam Reed, swindler and dream-duster—completely unfit to run a landside colony.

There was only one way out. Sam admitted his identity. He had been landside for forty years, he said. Stripping off his disguise, he showed the Keeps his face—not the face of a man eighty years old.

"I'm no Immortal," he said. "No Immortal was ever built like me. I'm a man like the rest of you. But I've learned why the Immortals won't let landside colonies get started. You know how hard they've worked to stop us—now I'm going to tell you the real truth—why!

"You can all be immortal!"

Zachariah said wearily, above the tumult, "All right, Reed. You'll get your korium. You think you've won. Now, is this another swindle? If it isn't—go ahead and give them immortality!"

When Israel out of Egypt came
Safe in the sea they trod;
By day in cloud, by night in flame,
Went on before them God . . . .
I see the country, far away,
Where I shall never stand;
The heart goes where no footstep may
Into the promised land.
—Housman, circa 1900

The wall was painted with a running mural of fantastic green seas banded with purple and white, washing the feet of velvety brown hills. There had been shores like that, once, long ago, on an incandescent world. The artist who painted these walls had never seen bare hills or a colored sea. There was a curious off-beat focus about his rendition of these imaginary things, and it showed all the more clearly now because in the center of his mural a square of brightly tinted moving shadows showed a real sea and a real shore, smothered in jungle, and a boat shooting forward on V-spread wings of water.

Two people sat quietly in the painted room, watching the images of the landside world rehearse in duplicate the action far above them. Kedre Walton, cross-legged on a flat cushion on the floor, was laying out a game of tarot solitaire on the low glass table before her, glancing only now and then at the flickering screen. But Zachariah Harker in his deep chair never moved his eyes from the flying boat.

"There they go, poor fools. There they go," he said, almost to himself. He held a little censer of burning vine-dust in one hand, moving it gently to and fro under his nose occasionally. The vine had once run heavy with white sap that

dripped poison on any landside animal rash enough to pass beneath it. Dried and burned, it gave out a slightly narcotic fragrance that soothed the senses and the mind. Zachariah inhaled a deep breath of the smoke and blew it out again toward the screen. "This time," he said, "Sam Reed's bitten off more than he can chew."

"How vulgar," Kedre murmured, flashing him a smile. It was a smile that literally flashed, for she had adopted today an extreme of a current fashion. Her heavy black ringlets were gilded, each separate hair sheathed in a film of gold and twisted into a great braided coronet like a helmet above her narrow Egyptian face. Even her brows were delicate arcs of gold, and a bead of gold winked at the tip of every lash.

"You look ridiculous," Zachariah assured her, blinking.

"Of course I look ridiculous. I'm just testing how far I can go. You'll see. Every woman in—"

"Look!" Zachariah sat up suddenly in his chair, eyes on the screen. Kedre turned, holding a card poised above the table, and the two of them sat motionless, watching the mimic action on the wall.

It did not look very real.

The boat was swerving in to a landing inside a long, encircling arm of breakwater, where a white pier jutted out into the pale sea. There were ten passengers in the boat, ten young men and women on their way to a promised immortality. Their heads turned this way and that in quick, nervous motions, watching the strange upper world that had always meant danger and improbable romance to the people of the Keeps. Like the youths and maidens traditionally borne to the Minotaur, they watched in excited apprehension the mighty wall of jungle drawing nearer and nearer, and the low, polished white walls of Plymouth Colony encircling the first island to be subdued.

It was no Minotaur that rose from the water in their path, but it was bent on exacting sacrifice. There were many saurian monsters in these seas. Not many yet had names, and the one that came dripping out of the milky water before the boat was unfamiliar to every watcher. Its darkly gleaming neck rose twenty feet with leisurely speed, water sliding like ragged silk from both sides of the great, gracefully bending arch. It opened a mouth that could encompass a man's head, opened it wide and hissed terribly. The mouth was solidly lined with fangs, rim, roof and sides jagged with them.

A chorus of shouts and screams, thin over the water, rose from the rocking boats as frantic passengers scrambled futilely toward the far side. The head dived down toward them, the neck looping after it like thick rope. There was infinite grace in the long, smooth, curving motion. The beast seemed to have chosen a girl near the front of the boat as its immediate victim. She had yellow hair and she wore a rose-red tunic, bright against the pale sea water.

For a moment pandemonium

reigned in miniature in the little boat. Then its pilot, moving with rather elaborately scornful precision, leaned forward and pushed a lever. From both sides of the boat translucent impervium slid upward, half-shells that met overhead with a click, shutting in the passengers and the crew in impregnable protection.

The diving head struck hard against the dome. The boat heeled far over, dipping its impervium arch deep into the water, tossing the men and women into a frantic tangle. The sharp keel flashed into daylight and the long dark neck of the monster struck it squarely.

An ear-piercing scream soared across the water. The saurian's fang-studded mouth gaped toward the clouds. Its curved neck straightened rigidly and from the gashed dark throat a jet of rose-red blood spurted, fantastically identical in color with the rose-red tunic of the girl.

The scream sounded again, more shrilly; blood gurgled in the long throat and gushed from the gaping mouth. The dark neck beat the sea twice and then slid downward out of sight. A beautiful carmine stain spread outward in circles from the spot where it sank.

The boat righted itself and swung in toward the pier.

Kedre laughed, laying down her card in its proper place.

"That pilot!" she said. "How bored he was with it all! It wouldn't surprise me in the least if Sam Reed had tied the beast out there for a nice spectacular welcome to his recruits. What a tale they'll have to tell!"

"Don't underestimate Sam Reed, my dear," Zachariah said gravely, moving the censer under his nose again. "He'd do exactly that, or something even more elaborately dangerous, if he saw any profit in it. He's a very dangerous person, Kedre—not because he's resourceful but because he's irresponsible."

Kedre nodded her glittering braided helmet. "You're right, of course. It's no laughing matter, really. Whoever would have dreamed he'd go so far as piracy! I think we can look for another act of violence the next time anything thwarts him and he can't see an easy legal way out. We've got a problem, Zachariah."

"Have you lost your taste for him, then, my dear?"

She did not look up, hearing that note of query in his voice. Instead she stirred the cards beside her with a pointed forefinger until she had uncovered the tarot called The Hanged Man. It was a beautifully wrought card like all the rest. The Hanged Man hung by his right ankle from a T-shaped tree against a background of elaborate gold-diapre work. A golden halo radiated around his serene face and hanging hair, which was red. Kedre reversed the card and looked at the small painted face thoughtfully.

"Don't ask me that, Zachariah," she said.

"You'll have to find an answer some day, my dear. It isn't just

a matter of a passing fancy, now. The man's an Immortal."

"I know."

"Do you know who he is?"

She looked up quickly. "Do you?"

Zachariah nodded, inhaled more smoke and fanned the cloud away from his face. Through it he said, "He's a Harker, Kedre. Do you know the story of Blaze?"

"I do now. I suppose everyone does. Sam didn't leave much to the imagination when he decided to tear down Harker prestige. Does *he* know, Zachariah?"

The Immortal laughed softly. "That's a very fine paradox. No, he doesn't know. He's put a great deal of energy and thought into the problem of discrediting us—so that no one is likely to believe anything a Harker says. When he finds it's his own name he's destroyed, I'd enjoy watching his face."

"'Destroy' is hardly the word, is it?"

"Oh, it isn't irreparable. We can win opinion back. We may have made mistakes—I'm beginning to think that we were mistaken about opposing colonization, for one thing—but our long-term motives have always been sound, and I think everyone knows it. Sam still thinks in short-term schedules. When we want to swing public opinion our way, we'll do it. Just now I'm inclined to watch and wait. Give him rope. The colonies have got to succeed now, of course. Much as I dislike the thought, we'll have to work with Reed on that."

Kedre turned up a card, started to lay it in place on the board and then hesitated, regarding it with a faint smile. Still looking at the picture on its face, she said,

"For awhile, yes. He's a bad man, Zachariah. However I feel toward him I realize that. He's got a way to go yet before he reaches the top. Until he gets there he'll do a better job than any of us could do. With the worst possible motives he'll do quite heroic things to establish a sound pyramid under him, something he can use as a basis for power. He'll establish the foundation for a good working social system. But only the foundation. Beyond that he can't go. He has no conception of constructive society. We'll have to stop him, then."

"I know. Have you any idea how?"

"Use his own methods, I'm afraid. Misdirection. Exploit his weaknesses and turn his strength against him. Tempt him with some irresistible bait, and then—" She smiled and flipped the card with a delicate finger.

Zachariah waited.

"I don't have a plan yet," Kedre said, "but I think I have the beginning of one. I must think about it for a while. If it's possible, it's the one weapon for which he'd have no defense."

"A weapon?"

Her gold-lacquered brows rose. She looked up at him under the heavy casque of gold, her mouth tucking in at the corners with that faint Egyptian smile that might be

no smile at all, but a look of pain. The gold brows gave her face a masklike expression and again she flicked the card with her nail. As well as he knew her, Zachariah could not fathom the things that went on behind her eyes when she wore that look. He had never seen it before.

Wordlessly he leaned forward to see the card. It was the Ten of Swords. It showed a gray amorphous seascape and a dark sunset sky, with the hilts of ten swords sharply outlined against it. Their ten blades stood upright in the body of a dead man.

The day came when Plymouth Colony got the first full quota of volunteers. Sam had waited for that day with a certain eagerness and a certain shrinking, but the eagerness was stronger. He had always preferred to come to grips with a problem—perhaps because so many of his enemies had proved irritatingly elusive in the past. The immediate hurdle was purely psychological. He had to make a speech, and he had to say exactly the right things to the thousands of immortality-seekers.

Facing the battery of visor screens, he drew a long breath while he studied his audience. Then he was ready. He knew what to tell them.

Sam said:

"You're a specially selected group. You've been screened carefully, and all of you have passed the basic tests. They were hard tests. We wanted the smartest, toughest, strongest material in the Keeps, because you're the shock troops of immortality."

He paused, glancing from screen to screen, at the thousands of faces intent on his own televised face.

"Not everyone can have immortality. After a certain time of biological life, senescence begins to set in. It doesn't necessarily show right away, and it comes sooner to some than to others. We still don't know what causes age, though we know how to stop it. Age may simply be a virus. Some day we'll find out. At present all we know is that there's a treatment that will arrest aging. But it seldom works on those over forty—perhaps because the balance has swung too far toward obsolescence by that time."

He let his gaze flicker again across the screens. There was danger latent in those waiting thousands. He held a live grenade in his hand. And he had to keep on holding it, till the last possible moment.

"You've all been screened and tested, physically and psychologically. You're the cream of the Keeps. You'll be the first to get immortality. Later, others will too, but you're the advance guard. You'll make it safe for the others—and they'll keep it safe while you enjoy the rewards of your work. It will be work. It will be hard. You must live landside for some years before you gain immortality."

Five years, he thought. Perhaps longer—but five years was the maximum he had allowed himself. Bearing that deadline in mind, he

has supervised the tests, rigging them, watching for vital points.

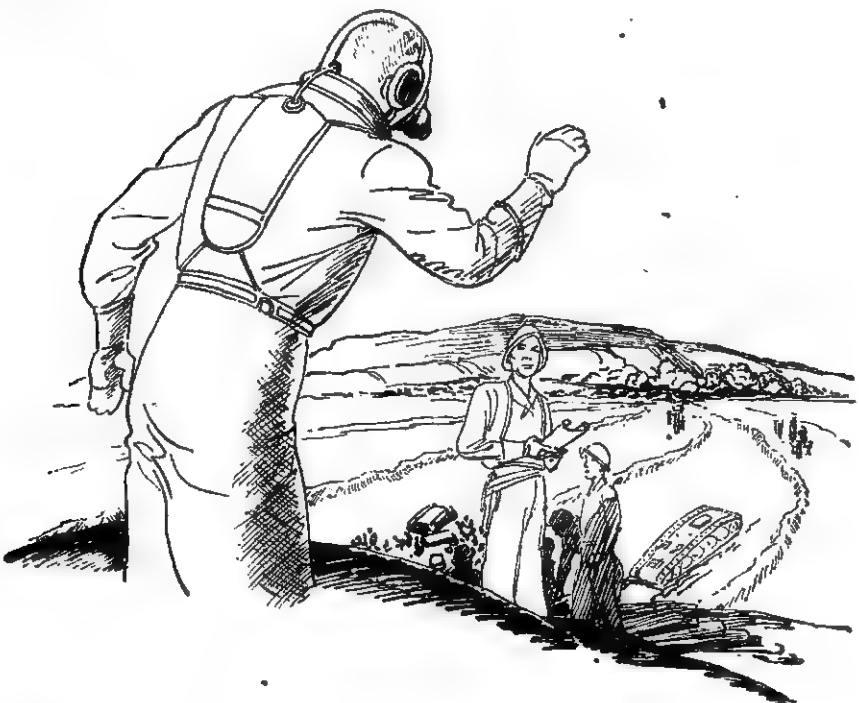
Screening thousands—later it would be millions—would have been a long, difficult job except that the machinery was already set up for Sam. The bureaus of vital statistics had records of most of the population with all pertinent information, including psychology, heredity, probable longevity—an important point!—and pathological propensity. Sam wanted smart, tough, strong men and women certainly—but one other factor was even more important. On that the success of his scheme depended.

He needed youngish, mature people. Because they wouldn't age visibly in five years.

The only way to prove or disprove immortality is by the empirical method unless—

He had allowed for that possibility, too.

He said, "You must live landside. Remember, I lived landside for nearly forty years. The treatment takes six or seven years for the average mature man. There, again, it may be because age is a virus, and the older a man is, the longer it takes to destroy that virus. If a child is exposed to the radiations at birth, as the Immortals' children have been, only a few treatments are necessary. There once more, it may be because the age-virus is not present in the newly-born. In such a case, the child



grows, reaches maturity—and stops at that point, living for hundreds of years, but growing no older.

"Babies born in the Keeps from now on will have that opportunity. With adults, it's another matter. You'll have the chance, but you'll have to work and fight for it. Because you must be continually exposed to the radiation for six or seven years, and that can't be done in the Keeps.

"We don't know too much about the radiation yet. The radioelement itself is present in the soil and air of Venus, but in microscopic quantities. For reasons we don't understand yet, exposure to solar and cosmic-ray radiation is necessary too. Later we'll learn more. Right now, we know this: we can give you the immortality treatment, but it will take years, and you must spend those years landside, so that the action will be cumulative.

"The process is too complicated to explain in detail.

"It works only on humans. We know that much. Like the ancient *bacillus leprae,* it affects humans but not animals. Guinea pigs couldn't be given leprosy, which was why researchers took so long to discover the cure.

"Immortality is for humans—for you. For all the Keeps. For everyone who isn't already too old to take the treatment. But to be immortal you must live on landside for a time. There isn't room in Plymouth Colony for you all.

"You must build new colonies.

"It's the only answer. We had thought of rotating the population in groups at seven-year intervals, but, to be fair, we would have to take the oldest men and women still able to benefit by the radiation. And they would remain at that age, while the rest grew older. We feel it best to choose people at the peak of their powers mentally and physically, so that they will remain so for hundreds of years. This way, too, the others won't have to wait seven years or fourteen or twenty-one. As soon as you've expanded the colony sufficiently, another batch will come in from the Keeps—and expand the colony farther. Thus everyone will benefit equally."

Sam studied the screens. They were swallowing it. Perhaps after five years they wouldn't, but until then no signs of age should appear that couldn't be explained away on the grounds of environmental influences. Colonizing Venus naturally would change a man.

You've got to earn immortality," Sam told the thousands. "You may be a bit confused at first in the transition from Keep life; the administration will allow for that. But remember that you must live landside for six years or more, and only by adapting to Colony tradition can you succeed.

"Those in charge here have learned how to cope with landside. They have authority, and you must obey them. We have our own laws—not Keep laws. This is landside. Landside is trying to kill us all every minute of the day and night.

You are colonists now, not Keep men, and you are subject to Colony law. According to the contracts you signed, you cannot become a Keep man again until formally discharged by the Colony. That will be when you are—immortal.

"Generally speaking, it won't be hard for anyone to readjust. Know your job. Be ready to step into the job of the man ahead of you. Promotion is going to be very rapid in the colony. Be ready for it.

"Immortality must be earned. The next six or seven years may be hard ones for us all. But you won't be giving up one-tenth of your life, you'll be giving up less than one-hundredth. Remember that. Seven years in the colony is the equivalent of *less than a month* after you're immortal.

"Remember that!

"Every time you feel discouraged, think of it. You'll be immortal. And there's no hard work a strong man can't endure for—one single month!"

Sam switched off the teleunit. He was alone in the room. He sat silent for a moment or two, watching the throngs who could no longer see or hear him.

Then he said softly, "Sugar-coated pills. But it always works. Always."

The crowds were still watching their screens, getting new orders from their individual unit commanders—members of Plymouth Colony's original settlers, the tough, trained men who had already worked under Hale and Sam. They were falling in line—figuratively and actually.

Expanding the Colony—sure. But along rather different lines. As raspberry plants expand and root by canes, so landside would be colonized. Not in five years—it would take far longer than that. But from now on new settlements would appear along the coasts, supported and guarded by Plymouth till they were self-supporting. Plymouth had to remain compact and strong.

The other colonies, the new ones that were to come—

There was a problem. They couldn't be vulnerable, or they couldn't exist against the interminable fury of the continent. Yet, Sam knew, they would have to remain vulnerable to *him*.

And Plymouth Colony had to become completely invulnerable.

He had five years before the pack could be expected to turn and tear him.

Link by strong link they forged the island chain. There was no time for relaxation. Even minutes were grudged. Nevertheless Sam thought Hale was dodging him.

When he walked into the Free Companion's office and found it empty, he made an angry noise in his throat and clicked on the desk televisor. "Where's the Governor?" he demanded.

"He's directing Operation Clearing, Island Six."

"Switch me over."

Presently the screen blanked—apparently Hale didn't have a visual

hookup where he was—and the Governor's voice said, "Hale speaking."

"Sam Reed. We had an appointment, didn't we?"

"Oh," Hale said, and his tone changed. "I'm sorry. Things are moving so fast—some new equipment we needed came in, and I found we could start on Six right away. Make it later."

Sam grunted and broke the connection. He went outside and commandeered a flitterboat. This time he was certain that Hale had been dodging him.

The pilot was one of the old Plymouth colonists; he gave Sam a soft salute and turned the little boat's prow seaward. They made a big, fast semicircle and swung toward Island Six. The other islands they passed were already colonized, the monstrous forests gone, planting already in progress. Huts were here and there. Quays jutted out at intervals, guarded by pillboxes. Islands One to Five were an odd combination of agrarian and military.

Five islands, only five, balanced against the huge continents of Venus that teemed with ravening life. Yet they were the beginning. Step by step the progress would continue.

Sam studied the pilot's face. He could read nothing there. When the danger came, it probably wouldn't come from the old Plymouth men; the late recruits from the Keeps would be the malcontents. And that time hadn't arrived yet; it wouldn't, Sam hoped, for years. By that time he should have established the tight control he wanted.

And Hale?

Where did Hale stand? Where would he be standing five years from now? That was beginning to worry Sam a good deal. The Keep Families he could cope with, because they were his enemies. But Robin Hale had all the cryptic potentialities of immortality plus a position that could become extremely dangerous to Sam. The pair were nominally fighting as comrades, back to back—which implied vulnerability. He couldn't figure Hale out. That was the real difficulty. How much did the Free Companion know or guess? Had Hale known, all along, that "Joel Reed" was really Sam Reed? And how much did Hale suspect about the phoniness of the Immortality treatment?

For all Hale knew, Sam might be telling the truth. If, as Sam argued, Immortals were exposed to the radiation soon after birth, no Immortal could actually remember such experiences. Yet the Free Companion wasn't gullible. Even his willingness to follow Sam's lead was somehow suspect. Hale's passivity, of course, might be due to attrition following arduous experiences; yet, even if that were true, the parallel warned Sam. Metal can become tired—but it can recover. A sword is metal.

Metal—metal. A new thought came to Sam. The Keep recruits—tough, strong, but so far malleable in his hands. They would go through hard struggles landside.

When metal becomes work-hardened—

The Sword again.

I must keep my back armored, too, Sam thought.

The flitterboat arced in toward Island Six. The jungles hid most of the land, except for a high knoll at one end. There was a copter there, and a man's figure silhouetted against the pearly sky. Barges and lighter craft were moving at temporary beachheads on the shore. Sam pointed; the pilot nodded and swung the flitterboat deftly aside, threading his way among the craft. The V-spray of water rushed up along the transparent prow-shield like rain.

It would not rain today, Sam decided, glancing up at the cloud blanket. That was good. Meteorology played an important part in Plymouth—landside conditions were bad enough anyway, without battling torrential rains, so jobs were apportioned according to the weather predictions. There should be a few clear days to work on Island Six and establish a base. Later, much later, a bridge would be constructed to Island Five, and the chain extended by one more link.

Sam stood up as the flitterboat grated against a quay. He jumped lightly on the jetty, instantly in the midst of confusing, ordered activity. A crusher rolled on its caterpillar treads from a barge and lurched monstrously up the beach. Lighter, mobile landcraft followed in its wake, specialized weapons for fighting the jungle mounted on huge-wheeled carriages. The men wore light protective suits and respirators. Heavy armor would only be a handicap at this point.

A tapir-masked figure touched Sam's arm and extended a bundle. "Better wear these, sir. There may still be bugs around—and the poison plants are pretty bad on this hunk of land."

"All right," Sam said, and donned suit and respirator. "I want to get up to the Governor. Is he on that hill?"

"Yes, sir. There's no road yet, though. He came in by copter."

"Find me another one, then."

The man thought for a moment, turned and shouted a question. After a while a twin-screwed gyro came down from somewhere and picked Sam up. Four minutes later he jumped out on the summit of the knoll from the hovering copter and waved to the pilot to proceed.

Hale wasn't wearing an aseptic suit or respirator, so Sam took his off. Up here, above the jungle, there was less danger of infection. Besides, both Sam and Hale had built up a good deal of resistance and immunity in the last few months.

Hale gave Sam a nod. He carried binoculars and a portable microphone, wired from his own grounded copter near by. He had no other equipment except for a large-scale map pinned out on a camp table before him.

"How's it coming?" Sam asked.

"Fair," Hale said. "The five-spray treatment hit the tolerance levels of most of the bugs. But you never know with mopping up."

Anything under a foot long was classified as a bug. That left the fauna—critters—and the flora—the green stuff. The operation meant a little more than merely mopping up, since the fauna was big and the flora was unpredictable and perilous.

But the five-spray treatment helped considerably. They had learned much in colonizing five islands. The first step now was to shower the island very thoroughly with solutions that didn't like bugs. One formula hit the lichens chiefly—a vital matter. Another damaged a good deal of the flora. The critters, at best, got slightly sick, but they charged at you with bared fangs and you could shoot them, if you were fast; they didn't have the unpleasant trick of infiltrating your lungs and sprouting quickly into a spongy mass that paralyzed your respiratory apparatus.

Island Six didn't look like the colonized islands or the raw ones now. It looked sick. The jungle wasn't a blazing green riot. It seemed to hang, like Spanish moss draped across the great boles, and occasionally slow, lethargic movements stirred in it. Sam could get a better picture now.

"There's another pair of binoculars in the plane," Hale suggested.

Sam got them. He studied the island below. He studied the men. There was something about the patterns of their movements that interested him—a briskness unfamiliar in the first Colony, certainly almost unknown in any Keep. Sam's interest in the jungle was purely superficial and subsidiary. To him the only truly interesting thing was his own kind and he spent long, absorbed thought on the motives behind every act that seemed out of the ordinary in his fellow creatures, his unconscious mind faithful to the concept that there might be something in it for Sam Reed.

These men were very happy in their work. It was something new on Venus. Sam knew their muscles must be aching at the still-unaccustomed toil, the sweat must be running uncomfortably down their bodies inside the protective suits. There was danger in every breath they drew and every move they made. But they were happy. The work was new and absorbing. They were creating. They could see the great strides of their progress simply by glancing behind them. This was the proper occupation of mankind—bringing order out of chaos in the sweat of their brows. It was good and right, and mankind had for too long lacked any pleasure in physical toil. Sam filed the thought away for that day when the pleasure in work gave way to boredom.

Then he glanced sidewise at Hale, still holding the binoculars to his eyes to hide the fact that he was studying his partner.

Abruptly he said, "Hale, what are we going to do about the Harkers?"

Hale spoke crisply into his microphone, waving one arm in perfectly futile gestures of direction to the invisible crusher, and then turned to Sam.

"What do you want us to do?" he asked mildly.

"They're too quiet. They let us win—maybe too easily. Once before they let us think we were winning, until they were ready to strike. I know—that was my fault. I was younger then. I didn't have much sense. This time I'm on the level—I know I've got to be. But I still don't trust the Harkers."

Hale regarded him with a quiet gaze that gave nothing away.

"Maybe," he said enigmatically. "How far ahead have you planned, Reed?"

It was Sam's turn to hedge. "What do you mean?"

"I mean there's going to be trouble in a few years—five or ten, wouldn't you say? Or have you figured on that yet?"

Sam sighed with some relief. So that much of it had emerged into the open, then. Since his triumph on the telecast, when he had forced the Immortals to surrender to his demands and snatched victory from defeat by a promise he could not keep, he had not spoken privately with Hale.

That was Hale's doing. He had taken care that there were always others present. And now it had somehow become impossible for Sam to ask him openly whether or not he had recognized Joel Reed from the start. There was a psychological pressure there Sam recognized and did not like. It meant that Hale had more power latent in him than Sam had quite counted on.

At least, one thing was emerging now—the immortality question. And Hale knew. Obviously he knew the truth. Still—he had tacitly accepted the fraud. He was making use of recruits who could have been won no other way, lending his name to a swindle beside which Sam's original deceit was nothing.

Realizing that clearly for the first time, Sam felt surer of himself.

"Yes, I figured on it," he said. "I wish I didn't have to. Maybe the end justifies the means—we couldn't have worked it any other way, could we?"

Hale's brow lifted a little at the pronoun. But the question itself he could not deny. He had accepted the benefits; he could scarcely refuse a share in the responsibility now.

"No, we couldn't. Or at any rate, we didn't," he acknowledged. "What we do with the scheme now will show whether it's justified. We'll have to watch that, Reed." It was a warning. "Do you have anything planned yet about how you'll meet that crisis when it comes?"

Sam had, of course. But he was quick to accept the warning. So Hale would go only so far in exploiting the candidates for immortality, eh? Very well, then, Sam's plans would have to remain disguised until the hour came for action.

"I've thought of several outs," he said carefully. "We'll discuss it when we have more time." He had thought of one safe out and one only, and Hale was a fool, he thought, if he didn't know it. When the promise of immortality showed itself a fraud, there was going to be

a tremendous surge of resentment against the men who had made the promise—Hale by implication, along with Sam. Violence would be the result; and you can meet violence only one way. Sam meant to be prepared for that day. If Hale disapproved of his solution, let Hale find a better one or take the consequences. Sam meant to provide for Sam Reed. And if Hale tried to interfere in Sam's plans about that vital subject, there was going to be conflict in Plymouth Colony.

Sam had an uncomfortable notion that Hale might be a more formidable opponent that he had heretofore guessed.

It seemed prudent to change the subject. Sam had found out most of what he wanted to know, but the thing which had ostensibly brought him here remained unsolved, and it, too, was important enough.

"About the Harkers," he said, "this time I think we'd better stay in touch with them. We've got more chance of watching out for their schemes if we're working together. And right now, I don't see how they can go on opposing our plans. Even they must know that if colonization is ever going to succeed, it's got to succeed right here in Plymouth Colony. If this fails, there'll never be another attempt."

"You're right, of course. I believe all the Keep Immortals must know that by now."

"Then they'll have to work with us toward the same goal, if their motives are as good as I've been told they are. We're the winners. I think it may be up to us to make the first gesture toward consolidation."

"Yes?"

Sam hesitated. "I don't trust myself to do it," he said with a burst of frankness. "Zachariah Harker and I are . . . well, we don't get along. Whenever I see him I want to hit him. You'd be a smoother diplomat than I am. You're an Immortal. You've known them all for a long time. Will you do it, Hale?"

Hale hesitated in turn. Then, obliquely, he said, "You're an Immortal too, Reed."

"Maybe. I suppose so. Not in the same sense, though. That's something I'll have to investigate some day, when I have time. It isn't important now. Will you go?"

Still Hale hesitated. While he stood there, evidently searching for the right phrase, the transmitter in his hand buzzed thinly with excited voices and he put it to his ear, relieved at the interruption.

For a moment he listened, peering toward the distant jungle where now and there a treetop could be seen to sway and go down before the juggernaut onslaught of the invisible crusher at its work.

"Take your binoculars," he said to Sam. "Step over to the left there—I think there's a gap where you can see across the quarter-line. You shouldn't miss this—they've run into a siren web."

Curious, Sam obeyed.

The binoculars seemed to lift the jungle forward and upward in one tremendous jump. The crusher had quartered the island, smashing flat

four broad avenues between which wedge-shaped segments of jungle still stood, drooping from the poisonous sprays, already paling from brilliant hues to drab. The nearer segment had already been nearly flatttened and Sam could see across it, and across the crushed avenue beyond, into the distant wedge of standing trees where the crusher was plowing methodically forward.

It was a monstrous thing, heavily mailed, lurching on its caterpillar treads with a ponderous, rhythmic gait not inappropriate to this jungle it moved through. The giant saurians of Venusian landside moved with the same vast, lurching tread, heaving their mailed sides through the trees no less majestically than the man-made juggernaut that had come to destroy them.

Vines wreathed it, hung in great swathes and matted tangles from its shoulders and sides. Some of the vines still feebly writhed against the metal, striking with fanglike thorns at the unyielding plate.

Sam could hear faintly the rumble and roar of the crusher lumbering on its way; the crack of breaking tree trunks came sharply through the air, and now the distant shouting of men running forward to watch the excitement was clear and thin over the distance between.

Then a flash of color just ahead of the crusher caught Sam's eye, and for an instant it seemed to him that all his senses paused. He did not hear the sounds from below or feel the binoculars pressed to his eyes or smell the heavy discomfort of the landside air, which he was still unaccustomed to breathe. There was only that flare of color that glowed almost in his face and then faded and blurred to another color more exquisite than the first.

Sam stood motionless while the two blended together and slid into a third hue clouded all over with paler tints whose motion as they coalesced was hypnosis itself. The colors were almost painful to see.

Abruptly he lowered the binoculars and looked questioningly at Hale. The Free Companion was smiling a little, and there was admiration in his face.

"You're a good man," he said with some reluctance. "You're the first person I've ever seen look away from a siren web that quickly. Most cant. You'd be a bad hypnosis subject."

"I am," Sam said grimly. "It's been tried. What is that thing down there?"

"A distant cousin of the happy-cloak organism, I imagine. You remember they make happy-cloaks from a submarine thing that subdues its prey through a neuro-contact and eats it alive—only the victim doesn't want to get away once it's sampled the pleasures of the cloak. The siren web works in the same way, only with a landside variation. Look and you'll see."

Sam looked again. This time he adjusted the binoculars to bring the colored thing into very near focus. It was impossible for a moment to see what the siren web really was, for again he experienced that stasis of the senses and could only gaze

with painful delight at the motion of its colors.

Then he wrenched his mind free and looked at it objectively. It was a very large web, probably an old one as age goes in these ravening jungles. Judging by the men who still ran toward it behind the crusher, he saw it must be nearly ten feet in diameter. It was stretched between two trees in a little clearing, like a spider web, anchored by strong interlacing cables to branches above and vines below. But in the center it was a solid thing, like fine membrane stretched taut, vibrating slightly with a motion of its own, and flushing with color after color, each more enthralling than the last, pumping faster and faster over the shivering web.

A faint twang of sound floated across the distance to Sam's ears, coming more slowly than sight so that though he saw each sound created by the vibrating cables and membrane, he heard it superimposed upon the next visible vibration. The sound was not music as human beings know it, but there was all the rhythm of music in it, and a thin, singing shrillness that touched the nerves as well as the ears, and made them vibrate ecstatically to the same beat.

The thing was exerting all its siren powers to lure the crusher to destruction. It flashed its most exquisite colors hypnotically in the faceless muzzle of the machine, it shrilled irresistible hypnosis to disrupt the synopses of the wire-linked nerves and paralyze the juggernaut tread.

And for a moment it seemed impossible that even a creature of steel and impervium could withstand the onslaught of that wonderful hypnosis.

If it had not withstood the siren, the men who were running forward now would have been lost. All Sam caught was a distant echo of the humming, but it made his brain work only in flashes, and in the flashes the color of the web wrought its paralysis of the mind. He knew that if he were running with those men behind the crusher he would probably run blindly too, to throw himself into the outstretched embrace of the siren.

"It's happened before," he told himself dazedly. "A long time ago in Greece, and Homer wrote the story."

The whole thing was over in a matter of seconds. To the last the siren flamed and shrilled, spreading out its web in a wide-flung promise of rapture. Then the nose of the crusher lurched forward and touched the center of the web.

In a flash the membrane leaped forward and closed about it. The cables drew thin and fine, screaming with a last vibration of triumph. And there may have been some faint electrical impulse to shock and paralyze the prey, for even the crusher seemed to hesitate for an instant as the glowing wings of the thing infolded its muzzle. Even the crusher seemed to tremble in every plate and wiry filament at the ecstacy of the siren's touch.

Then the juggernaut lurched on. The cables drew thinner, thinner,

tauter, paling from brilliance to translucent white at the increasing tension. They sang so shrilly the ear could no longer hear, but the nerves felt their last agonized vibration high up in the supersonic chords.

The cables snapped. The siren web clutched convulsively in one last spasm at its metal destroyer, colors flamed over it in impossible discords. Then it went flaccid and dropped limply forward, sliding down the mailed muzzle. The grinding treads caught it, carried it remorselessly to the ground, trampled it under into the debris.

And the thing that slid groundward was an enchanted web, a Nessus-shirt of burning color. But the thing the caterpillar treads crushed into the green melee beneath them was an ugly, rubbery gray mat that squirmed convulsively when the cleats caught it.

Sam let out his breath in a long sigh. He lowered the binoculars. For a moment he said nothing. Then he stepped forward, laid the glasses on Hale's camp table, and proved anew that he was no fit subject for hypnosis of any kind.

"About the Harker interview," he said, "when can you get away for the trip?"

Hale sighed, too.

"I can't," he said.

Sam frowned. "It's important. It's something nobody but you is really fitted for. I wish you could manage it, Hale."

"There's only one place where I'm really indispensable, Reed. Right here. Nobody else knows landside as I do. I'm no diplomat. You're our contact man. I'm sorry."

There was more to it than that. Sam felt perfectly sure of it. Hale was disassociating himself resolutely from every aspect of this game of deceit except one—the profit. The man power. That he would accept. The rest was up to Sam. And there was nothing whatever that Sam could do about it.

For the first time an unpleasant idea flashed across Sam's mind. Until this moment he had seen himself as the motivating force behind colonization. He had pulled the strings that moved the puppet figure of Robin Hale. But in the final analysis, he wondered suddenly, who was the puppet-master and who the dancing doll?

He shrugged.

"All right. I'll do it if I have to. But don't blame me if I make a mess of it."

"I won't."

Sam set his jaw. The matter was not really ended. He knew now where his real competition lay, and he knew the conflict had just begun.

The light was cool and clear as crystal. It was a room for working and thinking and planning. It had been designed by Immortals and for Immortals. The planes and curves were functional, but not obtrusively so; they flowed smoothly into each other, and the crystalline flower sprays and the changing picture designs on the frieze were part of the entire quiet, casual pattern. There was nothing to catch and hold

the eye for longer than a moment or two. But where the eye rested on shifting color or slow-budding, slow-flowering artificial crystal plant, the beholder found an anchor for his shifting thoughts, and could build new ones from that point.

In that cool, quiet place, brimming with a clarity of light that held steady from its invisible sources, Zachariah sat beside Kedre at a long desk. Her tapering fingers, with gilt nails, shuffled through the dossiers before her.

"You had better go to see Reed," Zachariah said.

Kedre lifted her shoulders in a delicate shrug. "Landside?" she asked. "Oh, no!"

"Aren't you the one best qualified to deal with him at this point?"

"Must we deal with him?"

Zachariah nodded toward the desk top. "You have a plan. But Reed's no fool. Misdirection—he's used that trick himself. We should have one real plan, and one overt one to distract Reed's attention."

"You don't know what I have in mind."

"I've got an idea. You must have based it on the theorem that Sam Reed is necessary now but will be dangerous at some later time."

She nodded.

Zachariah took one of her hands and ran his finger tips lightly across the gilded nails. "But when? We don't know that. And until then, Sam Reed will make his position stronger and stronger. He may be vulnerable now and invulnerable later. We can't strike now, though. Not if Venus landside is to be colonized."

"Hale was right, you know," Kedre told him musingly. "We did wait too long."

"Not quite—but we would have. However! One error doesn't mean failure. The question is, who's the pawn and who's the player? Reed thinks he's the player. He must remain so, until—"

"Until?"

Zachariah looked at a crystal plant, not answering till it had gone through its glittering cycle of bud and flower. "Until he's served his purpose and landside's safe. We can't set a definite time-period. So what we need is a bomb, planted now, which will explode when we set it off."

"That's my plan," Kedre said. "A bomb. The only possible time-bomb an Immortal can use against an Immortal, when we can't really read the future."

"And that is?"

"What can we plant near Sam that will stay with him always, potentially explosive, that won't deteriorate for, say, twenty years? That should be time enough. Sam must *want* that bomb near him. It must be something he will want and need. Something that can be custom-made, to suit Sam's requirements exactly, and especially something that Sam can't possibly suspect. A bomb that must seem so harmless Sam can investigate it thoroughly without suspecting its deadliness, even if he traces it back to its—construction."

Zachariah chuckled.

"Construction?"

"Birth."

"Of course. A human time-bomb. As you say, the only feasible one an Immortal can use against an Immortal, under the circumstances. What about the difficulties?"

"I need your help now, Zachariah. We've got to start *before* birth. We've got to plan our time-bomb from the very gene, train him every step of the way, and cover our tracks very thoroughly. I think I know how we can do that. But first—I've been using deduction, and then induction. Here's a brief of pertinent information from Sam Reed's dossier."

"Not the public—"

"I used our private files, too. Oh, we know more about Sam than he suspects. Psychologically we have him pretty well taped."

"He'll change in five years. Or fifty."

"We can make prediction graphs. And some basics won't change. He'll always have a weakness for the color blue, I know. Our time-bomb will have blue eyes."

Zachariah began to laugh. Kedre didn't. She made an irritated gesture and picked up a photograph.

Zachariah sobered. He looked at her shrewdly.

"I wonder what your motives are,

Kedre," he said. "I wonder if you know?"

She said calmly, "I isolated many facts from Sam's records, and built up a picture of what sort of man he'll want near him in, say, eighteen years. I'm predicting my picture on the success of the colonization plan, naturally. We'll have to work with Sam on that. Our time-bomb must be specially trained, so his talents and skills will be what Sam needs. Personality and appearance are important, too. Sam's conditioned to like certain types of voices and faces. And to dislike others. Well—I got that picture clear . . . what sort of man we'd need."

She found another photograph.

"Then I searched in vital statistics for a man and a woman. I checked everything about them—heredity, everything! I can predict almost exactly what their child will be like, especially since it will be conceived and born under certain conditions we'll arrange—not obviously."

Zachariah took the photographs, one of a young man, the other of a young woman.

"Do they know each other?"

"Not yet. They will. The man is ill. I had to arrange that. I had him infected—he had volunteered for the Colony. We'll keep him here, and we'll arrange for him to meet this girl. But we must never show our hand."

Zachariah, suddenly interested, bent forward, glancing at various charts.

"What's his work? Oh, I see. Mm-m. Give him something more interesting. Making sure they stay in Delaware will be tricky. I think we can pull the right strings, though. Yes, I'm sure of it. We can arrange for them to meet and marry—but the child?"

"Simple. We already know her fertility period."

"I mean, what if the boy turns out to be a girl?"

"Then she may have even a stronger appeal to Sam Reed," Kedre said, and was silent for a little while. Suddenly she pushed the girl's photograph away.

"Psychonamics is the rest of the answers," she said briskly. "The child, boy or girl, will have psychonamic treatment from the very start. Secret, of course. Not even his parents will know. There will be mnemonic erasure after every treatment, so the boy himself won't know he's undergoing continued hypnosis. And it'll amount to posthypnotic suggestion. In the boy's unconscious, by the time he's eighteen, will be a command he can't disobey."

"To kill?"

Kedre shrugged. "To destroy. We can't yet tell what will be the most effective treatment. Of course nobody can be hypnotized into committing any act he wouldn't do consciously. The boy must be trained so he'll have no compunctions about Sam Reed. There'll have to be some triggering response—we'll implant that hypnotically, too. He mustn't act until we set off his reaction, no matter what provocation he gets up to that time."

Zachariah nodded thoughtfully. "It's good. It's elaborate, of course,

too. A Robin Hood's barn sort of plan." He used the curious colloquialism without even thinking of its vastly faraway origin. "Are you sure we aren't overestimating the man?"

"I know Sam Reed. Don't forget his background. During his formative years he thought of himself as a short-termer. He's got a tremendously strong instinct for self-preservation, because of the life he lived in the Keeps. Like a wild animal's, watchful every second. I suppose we might kill him now—but we don't want to. We need him. The whole culture needs him. It's only later, when he's dangerous, that we'll want him destroyed. And by then . . . well, you'll see."

Zachariah, his eyes on a slowly unfolding stone flower, said, "Yes, it's a pattern, I suppose. Every autocrat knows how precarious his position is. We'd have been better rulers of the Keeps if we'd remembered that ourselves. And Sam will have to be an autocrat to survive."

"Even now it probably would be very hard to attack him personally," Kedre said. "And in ten years—twenty—fifty—he'll be really invulnerable. He'll be fighting every hour, every year of that time. Venus, his own men, us, everything around him. He won't be living in the Plymouth Colony we see on the visors now. Here in the Keeps nothing changes—it's hard for us to adjust our minds to the changes that are going to take place landside. Our own technologies will make his invulnerability possible—protective devices, psychological barriers, screenings . . . yes, I think we'll need something like our time-bomb to make sure of reaching him by then."

"It's elaborate in one way," Zachariah told her, "but I withdraw my Robin Hood's barn simile. In its own way it's extremely simple. Once you admit the need for the roundabout approach, you can see how simple it is. Sam will be expecting some tremendously complicated attack from us. He'll never dream we could lack deviousness to the extent that our single weapon is a gun in the hands of a boy."

"It may take fifty years," Kedre said. "It may fail the first time. And the second. The plan may have to be changed. But we must start now."

"And you'll go landside to see him?"

She shook her gold-coifed head. "I don't want to go landside, Zachariah. Why do you keep insisting on that?"

"He'll be wondering what we're up to. Well—give him an answer. Not the right one. He's no fool. But if we can make him suspicious of minor things, it'll occupy his mind and stop him from watching us too closely in our major project."

"You go."

Zachariah smiled. "I have a personal reason, too, my dear. I want you to see Sam Reed. He isn't the underdog any more. He'll have begun to change. I want your reaction to Sam Reed Immortal."

She gave him a quick, masked glance, the light glinting from her golden hair and golden brows and

dazzling from the flicker of golden beads that tipped her lashes.

"All right," she said. "I'll go. You may be sorry you sent me."

Hale studied the site of Island Six's ganglion, the cleared area where the local administration buildings would presently rise. Work progressed. In distant jungles, toward the coast, the rumbling roars of crushers could still be heard, but here there was constructive, not destructive, activity. The tree boles had been hauled away over a four-acre, area, and the ground had been ploughed up. Surveyors were already busy.

An old man was stooping down not far away, and Hale strolled toward him as he recognized the Logician. Ben Crowell straightened, his shrewd, seamed face alight with speculation.

"Hullo, Governor," he said. "Looks like good soil here." He crumbled loam between his calloused fingers.

"You're not expendable," Hale said. "You shouldn't be here. But I suppose there's no use trying to give you orders."

Crowell grinned. "Not a bit. Thing is, I always know what'll happen and about how far I can go." He examined the loam again. "Poisoned now, but it'll come back. When the anaerobic bacteria get to working—"

"First we'll flood the soil with bacteriophage," Hale said. The surveying crew and the diggers were some distance away; they could talk without being overheard. "One toxic treatment helps, but one isn't enough—there are too many dangerous bugs in the dirt."

"It's good dirt, though. Almost too rich. Over to the west there it's sour; needs liming. But you can get some nice crops on this island."

A man wearing a shoulder-tank equipped with a hose and what seemed to be a gigantic hypodermic syringe came past, moved to a labeled stake, and began working the telescopic "needle" into the ground. "One of them, huh?" Crowell said.

"One of the worst. Above ground it's just a creeper. But the root-reservoir's twenty feet long and ten feet down. Only way to kill it is pump it full of poison."

"Used to be something like that on Earth—Man Underground, we called it. Dunno the scientific name. Only we used kerosene to kill it. Stuff never grew quite as fast on Earth as it does here. Bad now, but it'll be an advantage when we get good crops in. Corn in twenty days, maybe." He shook his head, clucking appreciatively.

"If we can keep the weeds out."

"Only one real way. Pull 'em. You might try crab grass, though," Crowell suggested. "I'd back crabgrass even against Venus creeper, and you know what a strangler that is. Look, instead of letting some of the acres stay poisoned—that don't help the soil—why not put in some crab grass? Brother, it *grows!*"

"I'll check on it," Hale said. "Thanks. Any more ideas? Or is that against your rules?"

The Logician laughed. "Shucks, I can make suggestions. They don't

alter the future one way or the other —somebody was sure to try crab grass here sooner or later. It's only the big things I don't interfere with, if I can help it. They may not look like big things at the time, but *I* know." He peered through a swathe of fallen trees toward the coast. Far beyond, across the bay, was the mainland, where the cliff-like structure of the old Doonemen fort stood. There was activity on that weed-draped, lichen-stained hulk. Bright scarlet flashes blazed out and were gone. Boats kept up a continual traffic from the mainland to Island One and back again.

"What goes on?" Crowell asked. "Going to work on the fort already?"

"Sam's idea," Hale said. "I think he's afraid I'm beginning to take the initiative. I started work on this island without discussing it with him first. So he's pulling the same trick. That's fine."

Crowell considered. "So? What's the setup?"

"He's started to clear the old fort. Quite a job, and we weren't ready to tackle the mainland yet—but I think it'll be O.K. I'd say otherwise if the fort weren't already there. The Doonemen built it the right way. I remember—" He, too, looked toward the shore, his face changing a little. "There was always a maintenance crew on duty. The jungle was always ready to eat us up, if it could. The plants—and the animals. But the Keeps gave us equipment then; UV batteries, heat rays, acid sprays. The Free Companions always had two fights going on. One was irregular; wars against other Companies. But the fight against the jungle never stopped."

"Maybe Sam's bit off more than he can chew," the Logician suggested.

"No. He's got the equipment and the man power. Once he clears the fort, once he sets up his maintenance machinery, he can keep things running. He can't move back inland yet, but he doesn't want to. He's going to use the fort as an additional base, he says, and start working along the archipelago till he meets me. That'll save time—our working from both ends of the island chain. It's a good idea."

"Got enough men?"

"Five thousand," Hale said. "It's enough, but not too much. We're a little crowded yet, but we've got to have the man power reserve to fall back on for emergencies. Never know when you have to throw in shock troops against the jungle. And every mile we clear means losing a crew left to maintain it. Five thousand, and more coming when we have room to house and use them."

"No rumpus yet?" Crowell asked.

Hale looked sharply at him. "Expecting trouble?"

"Don't have to be prescient for that, son. Five thousand men doing hard work, and more coming—promising 'em immortality won't keep 'em quiet indefinitely. A fella has to go to town Saturday night and raise a bit of hell."

"What do you know about that

immortality business?" Hale asked, with a glance around.

The Logician merely grinned.

Hale looked toward the distant fort, where the red flashes of flame-splashers were burning the old walls clear. He said, "You know, and I know. Nobody else can be sure, except Sam. But his story is that you can get immortality from a radiation that exists on Venus. Well—you were born on Earth!"

"Oh, there was a certain amount of radioactivity flying around on Earth just before it blew up," Crowell said.

"There'll be trouble, though. You know one danger. It could happen here. That time, man left Earth and came to Venus. If it should happen again—"

"Kind of like a hermit crab. When it outgrows its shell, it crawls out and finds another. Mistake to stay in a shell that's too tight. Lots of things might make it tight. Growing too fast—which was what happened on Earth. These people—" Crowell waved toward the crew of workers. "Could be they're outgrowing the Keeps, only they never knew it. A man needs a lot of things, all in all."

"Are you going to stay in the colony?" Hale asked abruptly.

"Guess so, for a while. I'm a dirt farmer at heart. Why?"

"Oh, not because you're the Logician. You're an Immortal. So am I. The short-termers—you can't let yourself get too closely involved if you're immortal. The Keep Families . . . Sam . . . you're the only man on Venus who's my kind."

"We both spent the best parts of our lives under the sky, son," Crowell said. "And with our feet on good brown dirt. Not the longest part of our lives, but the best part. With me it was Earth, with you it was Venus, but it comes to the same thing. I know what you mean. I can feel at home with you, though sometimes you sure act like a cussed fool."

They watched the workers again. After a while, following a new chain of thought, Hale said, "We'll have to militarize. Sam suggested, but I had been thinking about it for some time."

"They don't look sharp, for a fact," Crowell said, examining the nearest crew.

"It isn't only that. We've really got a military setup here already, basically. Military discipline and organization. Like the old Companies, in some ways. But there ought to be uniforms, and what goes with them."

"Think so?"

"If you take away a man's freedom, you've got to give him a substitute, even if it's only a sop to Cerberus. Let him have safe outlets for his individuality. If he can't wear flimsy celoflex—and he can't here, he needs tough protective fabrics—give him a smart uniform. Service insignia, too, and insignia of rank. Recreational facilities—but organized and controlled. Promising immortality won't be enough, and militarization won't either, but together they'll postpone the blowup a little longer. With the Free Com-

panions it was different; we knew what to expect when we joined up, and we joined because we wanted to, not because of any rewards except the life itself—it was the life we wanted. These recruits now—I think militarization will have a good psychological effect." Hale, without seeming to do so, was watching the Logician very closely. "What I'm wondering is why Sam suggested the idea. I'd like to know *all* his motives for doing so. His future plans."

Crowell chuckled. "I expect you would, son. I expect you would."

Hale kicked the brittle wing-cased body of a foot-long bettle and watched it fly spinning across the clearing toward a heap of other glittering dead insects shoveled aside for disposal. One of the first results of the poison sprays on every island was the clattering rain of beetles that dropped like iridescent hail from the foliage, some of them large enough to stun the men beneath.

"You could tell me," he said stubbornly. "You could if you would. It would save so much—"

"Now there's where you're wrong, my boy." Crowell's voice was suddenly sharp. "Seems to me I've mentioned before that seeing the future doesn't mean a man can change it. That's always been the fallacy—thinking that if you know what's going to happen, you can avoid it. Let me give you a little lecture, son, on the problems of being prescient."

Crowell hitched his belt and dug a toe into the sod, turning over the rich dark soil appreciatively, spreading it flat beneath his shoe sole as he talked. And his diction changed with his subject.

"The truth is, generally speaking, the superficial currents of events don't mean anything. The big tides are important, but by the time they're big enough to notice, they're too big to be altered. A sea wall wouldn't do it. Because what makes the tide itself, that keeps pounding and pounding away?

"The minds of men—

"Back in the Twentieth Century a lot of men knew what was going to happen to Earth. They said so. They said it loud and often. And they were men who had earned public respect. They should have been believed. Maybe they were, by a lot of people. But not enough. The minds of men kept right on working in the same set patterns. And so we lost Earth.

"If you've got prescience you've got to stay a witness—no more. Remember Cassandra? She knew the future, but the price she paid for prescience kept her harmless—nobody would believe her. Prescience automatically cancels out participation. You see that certain prearranged factors add up to a certain equation. THOSE FACTORS. Add another factor—your interference—and the equation is changed too. That's the imponderable—your own interference.

"You see why oracles have got to speak in riddles? There've been plenty of prescient folks in history, but they had to speak vaguely or what they said wouldn't come true.

"Look now. Suppose two major

possibilities exist for you. You go down to Nevada Keep tomorrow and put across a deal that nets you a million credits. Or you stay home and get killed. Well, you come to me and ask me whether to go or stay. And I know these two possibilities are right ahead of you. But my hands are tied.

"Because both results depend entirely on your personal motivations and reactions. In possibility A, you'll have gone to Nevada Keep without consulting me, and with certain reaction-basics already existing in your mind. *Under those conditions,* reacting in exactly a certain way to a given set of circumstances, you'll make a million credits. But you consult me. I tell you, say, go to Nevada Keep.

"And you do go—but with a different psychological quotient. I've advised you to go. Ergo, you decide something nice is waiting for you there and you go with a passive attitude, waiting to stumble over a bag of gold, whereas your earning your million credits depends on alert aggressiveness. You see?

"Or here's another possibility. Unconsciously you don't want to go. You rationalize my answer to the point where you stay home, deciding I'm a liar, maybe, or that my advice was really to stay, not go. So you get killed.

"So my job is to keep the factor constant as given, without changing them by introducing the catalyst of my own oracle. I've got to do it subtly, gauging your psychology. And that's tricky. I have only limited information to go on. Prescience works by rules of logic basically. It isn't magic. Knowing you, I've got to find certain ideas, semantic groupings that will influence your decision without your knowing it, without altering your original emotional attitude. Because that original attitude is one of the factors in the final equation my prescience has foreseen.

"So I can't say, 'Go to Nevada Keep!' That would mean you'd go passively. I've got to phrase my advice in cryptic terms. Knowing what I know about you, I might say, 'The kheft tree has blue leaves,' and you might be reminded of certain affairs—apparently natural, spontaneous thought-processes on your part—which will create a desire to get away from home temporarily. That way I sidestep—if I'm deft enough—introducing any new element into your original psychological pattern as of that moment. You go to Nevada Keep, but ready to react according to the original pattern.

"You make your million credits.

"So now you know why oracles speak in riddles. The future depends on imponderables which can so easily be changed by a word. THE MOMENT AN ORACLE PARTICIPATES, PRESCIENCE IS LOST."

The Logician stamped his turned clod flat. Then he looked up and smiled wryly. "Also," he said, "this presupposes that it's advisable, in the long-term view, that you should make that million. It may be bet-

ter for you to stay home and be killed."

Hale was looking at the flame that washed the walls of Doone Fort clean. He was silent for awhile. "I suppose I see what you mean," he said finally. "Only—well, it seems hard to stand this close to all my answers and not be able to get at them."

"I could hand you an answer to every problem you'll ever meet, all written out in a little book," the Logician said. "So you could flip the page and parrot out your answer whenever you needed one. What good would that do? You might as well be dead to start with. And I'm an oracle only within certain limits. I can't answer all questions—only those I've got full information about. If there's an unknown factor—an x factor—I can't foresee anything reliably about that question.

"And there is an x factor. I don't know what it is. I realize now I'm never going to know. If I did, I'd be God and this would be Utopia. I recognize the unknown quality only by its absence, its influence on other factors. That's none of my business or yours. I don't let it bother me. My business is to watch the future and not interfere.

"The future is the mind of man. It wasn't atomic power that destroyed Earth. It was a pattern of thought.

"It's easier to control a planet than to control that dust-mote there, blowing around unpredictably on currents we can't even feel. Blowing on a current created by your motion when you reach out to control the dust-mote—which is a thought—and the future of mankind."

Curve beyond great white curve, the walls of Doone Fort stood pearly against the jungle. To Sam, looking up at them from the cleared white floor of the *enciente,* they seemed tremendously tall and powerful. Curve upon thick, smooth curve, they seemed to beat back the forest, to encircle in a jealous embrace the foothold of life within them. Their lines were the lines of waves and of all things carved by waves, instinct with a meaning men can recognize without in the least understanding.

Three stories high the smooth, rounded walls rose, broken by windows that glittered with interlacing screens of light to filter out the bugs visible and invisible. These forts had been built on much the same scheme as medieval castles, to withstand attack from ground-level, horizontally, by men, and by air from bacteria and flying things as medieval men built to withstand flights of fire-arrows. There was a close parallel, for attack by planes had been unknown in the early days on Venus. The Free Companions respected each other's forts. And air travel then as now was too wildly erratic, dependent on currents and torrents of wind too dangerous to attempt.

There was a great deal of activity here. Around the great curve of the *enciente* the barracks and the shops stretched, seething with men.

In the higher buildings at the inland end were the hospital, the labs, the officers' quarters. The outer walls curved down to inclose a small harbor with a heavily fortified barbican giving onto the piers outside.

A flurry was in progress at the open barbican, though Sam had not yet noticed it. Men and women already browning from the filtered sunlight paused in their activities and stared frankly, drawing back out of a respect generations implanted in their forebears to let the Immortal through.

Kedre came up the courtyard serenely, smiling at the watchers, now and then greeting someone by name. Her memory was phenomenal; Immortals cultivated the faculty. Her adaptivity was phenomenal, too. In Keep attire she might have looked garish exposed to daylight, but she was too wise to attempt it. She wore a long straight cloak the pearly white of the Fort itself, and her head was swathed in a white turban very cunningly wrapped to make the most of her aloof beauty. White in a sunny world would have been blinding; here Fort and Kedre alike glowed nacreous in the misty day, gathering all light to themselves.

She said composedly, "Hello, Sam."

He clasped his hands before him and bowed slightly in the semi-oriental gesture of greeting that had for so long replaced the handshake. It was his first recognition of her existence, done formally and this time between equals. He could afford it now.

She laughed and laid her narrow hand on his arm. "I represent all the rest of us down below," she said. "We hope we can work together in peace from now on. I . . . heavens, Sam, how can you breathe this air?"

It was Sam's turn to laugh. He whistled, and a young man who had been following him with a notepad and stylus came up from the respectful distance to which he had retired. "Bring a pomander," Sam told him.

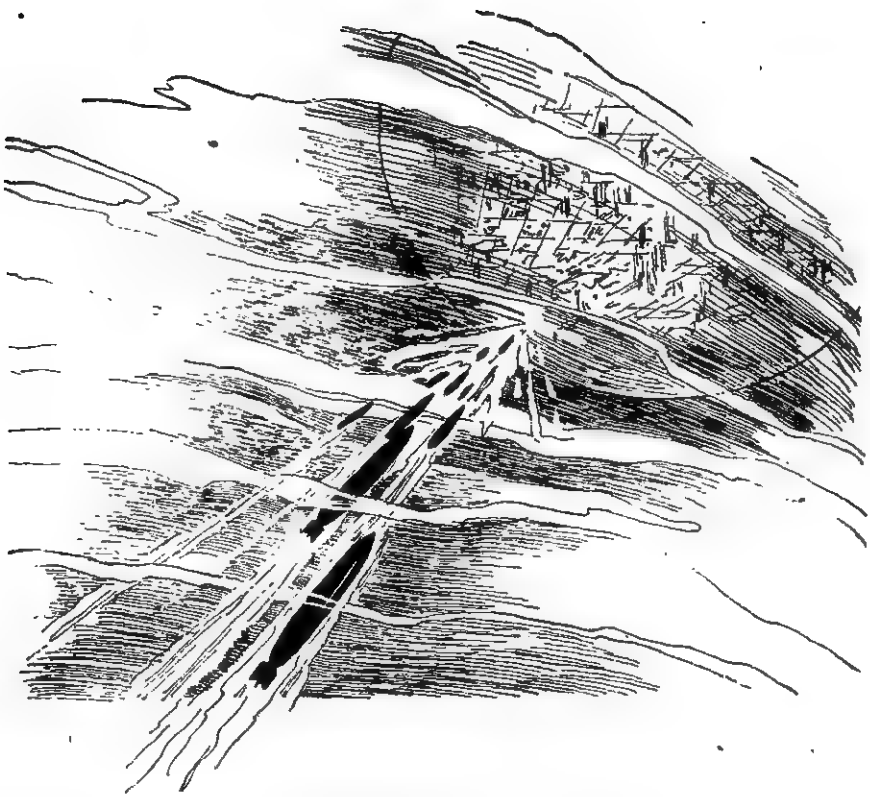
The boy came back at a run, and Sam put the perforated ball of plastics into Kedre's hands. It was filled with fresh flower petals and the warmth of the palms released a heavy cloud of perfume that made the air seem pleasanter to breathe.

"You'll get used to it," Sam assured her, smiling. "We all do. This is an honor I hadn't expected so soon. I'd meant to call on you first."

"You're busier than we." She said it graciously, and then pulled a little at the arm she held. "Do show me around. I'm so curious. I've never seen the inside of a Fort before. How beautiful it is up here! If only you could do something about this unbreathable air—"

"Wait awhile. Wait twenty years. These jungles are too thick now. They give off too much carbon dioxide, for one thing. But wait. It's going to be better."

She walked beside him slowly, her spotless cloak-hem brushing the white pavement. "I believe you,



Sam," she said. "We rather incline now to thinking you were right. This is time to colonize, not a generation ahead. Your methods were abominable, but the end may justify them. I'm sure it will if you'll let us work with you. You're a headstrong fool, Sam. You always were."

"You didn't object to it forty years ago. I haven't thanked you for switching the dream-dust for me, Kedre. Or for having me looked after while I was—asleep." He said that without so much as a glance at her, but from the sudden twitch of her fingers on his arm, and the way she paused to look up, he knew he had guessed wrong.

"But Sam, I didn't. I tried, but you'd disappeared. Do you mean you don't know where you were all that time? I'll put my men to work on it—maybe we can find out something."

"Do if you like. I doubt if they can turn up anything my men couldn't."

"But Sam, that's . . . it's almost frightening! Because we know someone did take care of you. You couldn't have vanished for forty years like that without . . . Sam, who could it have been?"

"I'll find out, some day. Forget it. Look—this is the jungle. The real thing, not just something on the screen. What do you think of it?"

They had mounted the white outer stairs leading to the battlements. Now Sam paused and leaned on the parapet, looking down at the belt of raw ground surrounding the Fort, and the solid walls of greenery beyond it. Sounds and scenes and subtle motions came from the undergrowth that were frightening because they were still so mysterious. Man had not even scratched the surface of the Venusian jungle yet and all its ways were alien and strange.

Kedre gave it one glance and then turned her back. "I don't think about the jungle at all. It isn't important. This is." She gestured toward the teeming courts below. "You've got a tremendous job to do, Sam. And you're almost single-handed. I know Robin Hale handles the actual working parties, but that's the least part of it. Will you let us share your work? We've had a great deal of experience, you know, in handling men."

Sam laughed. "Do you think I'd trust a one of you?"

"Of course not. And we couldn't trust you. But working together, we'd keep an eye on each other. You need a check and we need impetus from you. How about it, Sam?"

He looked at her in silence. He was remembering the moment before the dream-dust shut out all sight and sound, her face watching him from the visor screen and her hand giving the order for his extinction. He knew she must be here now for some motive more devious than the overt one. His mistrust of all other human beings and of the Immortals in particular, was profound. And his mind, which until now had been tentatively half-open toward co-operation, dubiously began to close. Sam's early training had been too complete. It was not in him to trust anyone.

He said, "It wouldn't work. Our motives are too different."

"We'll be working toward the same goal."

"I couldn't do it. I've always worked alone. I always will. I don't trust you, Kedre."

"I don't expect you too. But have it your way. Remember this, though—we both want the same thing, successful colonization of the land. Whether you like it or not, we'll be working toward the same end, down below. And Sam—if after a few years have gone by we find we're at cross-purposes again, remember, it will be you, not we, who have gone astray." There was warning in her voice. "When that time comes—and it will—there's going to be trouble, Sam."

He shrugged. He had just taken, though he did not know it, the first definite step toward that isolation of the mind and body which in the end was to mean his downfall.

"So it's taken five years," Ben Crowell said. "Just about what I figured."

The man walking beside him—Platoon Commander French—said: "You mean—us?"

Crowell shrugged noncommittally and waved his hand. He might have been indicating the darkness beyond the rampart on which they walked— the pillbox-dotted, cleared lands in which a man might walk for three days in a straight line in safety. It had taken five years to clear seventy-five miles, a great bite taken out of the jungle with the fort as the focal point.

Nothing could be seen now. Floodlights, with charged wire-mesh shields to guard against phototropic bugs, showed part of the ground outside the wall, but in the dark beyond the safety area stretched far inland. The fort had changed too. It had expanded till it crouched on the shore like a monstrous armored beast, so huge that if it had been alive, it could never have walked the earth of Venus.

Curious—earth of Venus. A paradox. Mankind would always carry with him his terrestrial heritage, though he carried his colonies beyond Cygni. The old words, the old thoughts—

The old motives.

Platoon Commander French touched Crowell's arm, and they turned toward a sloping ramp, past the masked muzzle of what seemed to be a strange sort of gun. French indicated it.

"See?"

"What about it?"

"Oh, you'll find out. Come on."

As always, the courtyards teemed with activity under bright lights. Crowell and French walked through the tumult briskly—only furtiveness was suspect, and their openness was a good mask. They entered an outbuilding. French took the lead.

The fort was a labyrinth now. Technically the chamber the two men entered presently was classified as a storeroom, but it served a different purpose at the moment. Nearly fifty men were here, drawn from all levels of colony life. Somebody gave a soft challenge.

French said, "Hello, Court. This is Ben Crowell. I'll vouch for him. Sit down over here, Crowell—and listen."

He moved to the front of the room, holding up his hand for attention. "All set? Shut the door. Got the guards posted?"

A man said, "Step it up, French. Some of us have to be back on duty pretty soon."

"This won't take long. Listen. There's about a dozen new men here tonight—right? Hold up your hands."

Crowell was one of those who raised his arm.

"All right," French said. "We'll be talking mostly for your benefit. You're all convinced already, or you wouldn't be here. And you won't do any talking to the wrong people after you get out of this room—we chose you carefully."

He hesitated, looked around. The main thing—is there anybody here who still believes in Reed's immortality gag? That phony Fountain of Youth?"

A voice said, "There's no proof either way, is there, commander?"

French said, "I came here five years ago. I was twenty then. Island Five had just been cleared. Everybody was talking big—big plans for the future. Immortality for everybody. The treatment was supposed to take six or seven years."

"Well, it's only been five for you, hasn't it?" the same voice asked.

"You don't have to wait a hundred years to be sure. Some of us have been seeing Keep doctors. We're getting older. All of us. There's a way of checking—the calcium deposits in the blood vessels, for one thing. Those treatments of Reed's are fakes. I know I'm five years older than I was when I first hit Plymouth, and the same thing goes for the rest of you. Reed's crossed us up. Look at his record—you can't trust him an inch. Five years I've been sweating up here, when I could have been back in my Keep taking it easy."

"I kind of like it landside," Ben Crowell put in, stuffing tobacco into his pipe.

"It could be all right," French admitted, "but not under this setup. All we do is work. And for what? For Sam Reed and Robin Hale—building, building, building! Hale's an Immortal; maybe Reed's going to live seven hundred years too—I don't know. He doesn't seem to get any older. Maybe he did find the Fountain of Youth, but if he did, he's kept it for himself. Know what that means? We work! We work till we die! Our children work too, when their time comes. And Sam Reed just hangs around and waits a few hundred years till we've done his job for him and fixed him up a nice, comfortable setup that's just what he wants. Well—I don't see the profit!"

A new voice said, "You're right. I agree. But Reed had to get the fort built strong. You were here five years ago; you know what it was like."

"He's in too much of a hurry. Discipline—there's too much of it. He's got plans of his own, and we're not told what they are. Colonizing landside isn't all of it. Sure, we needed that fort five years ago—and we needed it strong. But what about all this top secret armament work? Nobody's supposed to know about the new gun emplacements on the walls—the electric-spray blasters, and the gas throwers. But they're being set up."

"The jungle?"

"Seventy-five miles away now!" French said. "And some of these new weapons—they don't make sense! Kalendar, you're a logistics man. Tell 'em."

Kalendar stood up, a short, swarthy figure in a neat blue uniform. "They'd be useful for defense against human enemies. They could fight off and smash an onslaught by tanks, for example. But they're more powerful than we need even against a thunder-lizard. Besides, there are long-range cannon being cast and set up—they've got everything from radar calibration to video reactors. They'll throw a shell five hundred miles away and hit the target. What are they going to be used against? Another bat-

tery aimed at the fort? And our new plane construction program—you don't colonize by plane!"

"Exactly. What's Reed expecting?" French asked. "Attack from the Keeps? The Keeps don't fight. They're living a life of glory down there, taking it easy, while we work ourselves to death."

A low growl of resentment arose. These men didn't like the people of the Keeps—jealousy, probably. But the sound hinted at something new on Venus, just as this secret meeting foreshadowed a result Sam had not expected. For Sam had always been used to dealing with Keep people, and this was a new breed of men.

Ben Crowell puffed at his pipe and watched interestedly.

There was a burst of argument now, violent and angry. The plotters talked a lot—naturally! It was an escape from discipline. They were taking out their emotions in hot argument instead of in action. When they stopped talking, the volcano would probably erupt.

Ben Crowell settled himself more firmly, his back against a packing case.

"—whatever Reed's planning—"

"—let the Keep people do some work—"

"—how much more time are we going to give Reed?"

"How long are we going to sit and take it?"

French hammered for silence.

"We've got several plans. But we've got to figure well ahead. Suppose we kill Reed—"

"That wouldn't be easy. He doesn't take chances!"

"He can't win if most of the colony's against him! And it will be. We've got to spread our organization. Once we get rid of Reed—and Hale—we'll be on top and able to stay there. We'll have the fort. And there isn't a thing on Venus that can smash the fort!"

"Hale's no fool. Neither is Reed. If they get wind of us—"

French said: "Every man takes a lie-detector test before he leaves one of our meetings. No traitors live."

"I haven't lived a thousand years without figuring out how to fool a lie-detector," the Logician said to Hale.

Hale turned away from his light-latticed window that looked down so far on the walls which had once seemed so high to them all. He said coldly, "I know you were at that meeting. I have spies, too."

"Did your spy recognize me?"

"He didn't recognize anybody. He got there afterwards. But he smelled pipe smoke and that rank tobacco of yours. Anyway—I know a little about what goes on around here."

"What, for example?"

"I know when discipline begins to fail. When men are sloppy about saluting. When they don't polish their brassards. I learned discipline in the Free Companies. I saw the crack-up start in Mendez's company before his men killed him. I noticed signs of trouble here months ago. That's when I put my spies

to work. I knew what to expect, and I was right. It's beginning."

"What?"

"Mutiny. I know a few of the ringleaders—not all."

"Does Sam Reed know?"

"I've discussed it with him. But —I think he discounts the danger. He's been guarding himself so thoroughly he mistakes personal safety for colony safety. I want you to tell me what's going on. I know you can. If you don't, I can get the information elsewhere, but I'd like to discuss it with you if you're willing."

"I know you can find out elsewhere," Crowell said. "I'll be glad to talk. I've been waiting for you to ask me, hoping you would, because I couldn't volunteer anything without upsetting the pattern. I got into this passively, you know. Guess I looked like a malcontent. God knows why. No, I do know. Do you?" He squinted at Hale over the hand that cradled his pipe.

Hale shook his head. "No, I . . . wait. Maybe I do." He strolled to the window again and looked down at the busy courts. There was much more of a pattern to the activities in Plymouth Colony than there had been five years ago. Discipline had stiffened into iron rigidity. It seemed to the average man that as the need for discipline lessened with their growing conquests of the land, the meaningless forms of it grew more and more inflexible.

"Sam has his reasons," Hale said, looking down. "I don't know what they are, but I can guess. His time's running out. The balance is going to shift pretty soon. Men are losing faith in immortality and beginning to wonder. Sam knows the balance is tilting already, but I don't think it's dawned on him what he's weighing in the balance. Men. And not Keep men any longer. Men like you and me, who know what independence means. No wonder they spotted you for a malcontent. You've lived in a world where every man had to shift for himself or go under. So have I. I suppose the marks of it are plain on us."

"Right." Crowell grinned. "Keep people want their leaders to do their thinking for them. Our men landside have had to think for themselves. Those who didn't—well, they just don't survive. It's the old pioneer feeling come back, son, and I like the feel of it. It means trouble, but I like it."

"Trouble is right. Serious trouble, unless we move at the right time."

"Now?" Crowell was watching the Free Companion keenly.

"Not yet," Hale said, and the Logician's smile was faint, but satisfied. "No, not quite yet. Partly I want to sound this thing out, see how far it's going to spread. Like the Man Underground plant, you've got to locate the root. And partly —I don't know, exactly. I've got a sort of feeling that something's working out in these mutinies and plots that shouldn't be crushed. It's the pioneer spirit, all right, and I feel the way you do. I like it. Mutiny isn't the answer, but mutiny's a good sign, in a way."

"You going to let them go ahead, then?"

"No. I can't do that. At this point they still need Sam and me, no matter what they think. Let the mutineers take over and they'd wind up down in the Keeps again, sinking back into the old apathy. This is a crucial period. Sam's got some sort of plan I don't understand yet, but I'm betting on Sam to come out on top. Sam can take care of himself. His reaction to the mutiny, if he took it seriously, would simply be to stamp it out. And at this point that might mean stamping out the independent spirit of pioneering along with it. I'll have to think it over, Crowell. No use asking you for suggestions, is it?"

Crowell peered intently into his pipe, which had gone out. He poked ineffectually at it with a calloused finger. "Well," he said slowly, "I don't think you need much advice, my boy. You're on the right track. Don't interfere any more than you've got to. There are natural processes at work leveling themselves off and the longer they operate on their own, the better. You know something? I think just living up here landside has done one mighty big service to these people. They've discovered Time again. Down below day and night don't mean much. One season's pretty much like another. But here, you *see* time passing. You get the sense of it's being later than you think. These boys and girls started out with the idea they were going to live forever. They had a long-term view. They were willing to work for a colonization they hoped to enjoy themselves, in person, two-three hundred years from now. But that's passing. Time's passing. And they're suddenly waking up to it. No, I'd let these natural forces level off if I were you. As you say, Sam Reed can take care of himself."

"I'm going to let him," Hale said. "You'll keep an eye on these meetings, then? I know they've got a lot of schemes under way, but nothing's near completion yet, is it?"

"They're still blowing off steam. They'll act, but not for awhile."

"Spy away, then. I won't move until I have to. I'll wait—that is, unless Sam moves first.

Sam moved first.

As usual, he timed himself carefully, integrating every detail, and his action was spectacular, which made a few people wonder what Sam had up his sleeve. But, of course, they couldn't be sure. Some of them never were sure, even after the fantastic gambit was played. As a gambit it was effective—it was check, though not quite checkmate, and the arena from now on would follow even more closely the imagery of the old poet and his great translator—a checkerboard of nights and days. As for the Opponent—the Unseen Player—not even Sam had penetrated that mysterious symbolism. Who *was* the Player? The Harkers? Venus? Another part of Sam?

He knows about it all . . . .He knows . . . .he knows . . .

It was a chilling thought, but, Sam realized, there wasn't anybody who "knew about it all." Certainly not the future, and even the present was difficult enough to interpret in every detail and trend.

Still, he was ready; zero hour had struck, since he had got word certain secret arrangements of his own had been completed. He was in one of his private offices in the great tower he reserved for his own use. Part of that tower was top secret. But this office wasn't; port windows looked seaward toward the archipelago, now covered with farms and little settlements, though the protective pillboxes remained.

He avoided Hale's gaze. He was examining a flat cube on the table before him. It was like a very deep picture frame. But what it held was a siren web, flushing slowly from rose to deep scarlet. Sam opened a silver box on his desk, took out an insect, and fed the siren web through a miniature hinged door. A faint odor of perfume escaped at the same time, and there was a low, rhythmic humming.

"Put it away," Hale said. "I've smelled that odor too often! What about Crowell?"

Sam slid the siren web frame aside. "I didn't know he was working for you. He was one of the mutineers, that's all. So I had him arrested with the others."

"Why did you act without telling me? Why wait till I was forty miles away on an inspection trip?"

"You got here in half an hour," Sam said. "Anyway, I had to move fast. I've found out that there's more to this plot than you ever suspected, from what you've been telling me about it. Crowell may be your man, but he's an inefficient spy."

"I want him released."

Sam shrugged. "Of course. But his usefulness is over, isn't it?"

"Not necessarily."

"A visor call would have done the trick. You needn't have rushed back here."

Hale said, "I didn't want any chance of a slip-up. Crowell's got to be released. Accidents do happen. The wrong order, the wrong interpretation by a guard—"

"I've never seen you so concerned about any one individual. Why is Crowell so important?"

Hale hesitated. Finally he said. "Well—I trust him."

Now it was Sam's turn to pause. He said softly, "Trust? You mean you'd trust him with a gun behind your back?"

Hale nodded.

"Maybe some day I'll find a man like that," Sam said wryly. "So far I haven't. Well, let's get Crowell released. It's almost time for the trial."

"You're holding it today?"

"Yes. I've found out so much—unexpectedly—there are dangers. Worse ones than we'd suspected. Our enemies are better armed than we know. Perhaps they've got Keep backing. I don't know. But I haven't time to tell you now; I've arranged for Venus-wide videocasting of the trial, and the Keeps will be tuning in in a few minutes.

Come along. You'll find out what the setup is."

But he paused long enough to feed the siren web another insect. Hale said, with strong distaste, "Where did you get that thing?"

"Oh, it's a trophy."

"Young one. Going to keep it? It'll grow—"

"I expect it to."

"It'll grow dangerous. It's a siren web, Sam."

Sam said, "Still, imagine it twenty feet across. Up on the wall there—"

"With you walking into its mouth."

"I'm not a good hypnosis subject, remember? Anyway, I'll take precautions when it really gets big. Polarized glass or a stroboscopic attachment, a special filtering tonometer for its siren song, some gadget to cut the scent to safety level—the trial's starting. Let's go."

They went out together.

Hale said, "How many mutineers have you rounded up?"

"About seventy. Some of them will be useful in the right places. Others are too dangerous to let live —" Sam stopped abruptly. He had almost said too much.

Crowell's release came first, but afterward they went to the room where the trial was to be held. Batteries of visor screens were already set up. There were guards, plenty of them. And the seventy-odd prisoners, unmanacled, were herded together in a railed pen.

Sam started talking abruptly. He was talking to the colony and the Keeps as well as to the prisoners. He began by describing the activities of the malcontents, his growing suspicion of such an underground organization in the colony—"a colony expanding every hour, succeeding conquering landside so in a day to come men will be able to live under the open sky—every man and woman on Venus!"

He had arrested the plotters. But the plot had ramifications stretching deep underground. There had been a great deal of secret theft—theft of vital equipment, technological equipment, even materials for weapons. Why?

The screens focused on the prisoners.

"You men are cat's-paws," Sam told them. Originally you were the ones who started this potential rebellion, but someone else has taken it over. Someone who has kept his identity completely secret. Either you don't know who he is or you won't tell me. You've been questioned. Who is your secret leader?"

Silence.

"What are his plans? Is he a Colony man?"

Silence.

"We have proof. The equipment went somewhere. And there's other evidence. We'll find him, and the rest of his band; he's a menace not only to the colony but to the Keeps. If such a man should seize power—"

The menace hung unspoken over Venus.

"We will find him eventually. We ask the Keep's co-operation in this. But now—you men have been guilty of treason. You plotted to

overthrow the colony government and take control. After that, you intended to rule the Keeps as well."

A man thrust himself forward from the other prisoners. His voice cried thinly across the visors.

"I'm older! We're all older! Where's the immortality you promised us?"

Sam said contemptuously, "I'm not a fool, Commander French. I've known for a long time that this plot was going on, and I knew most of the men involved. Why should I give people like you immortality—to plot further? None of you have been given the immortality radiation treatment for many months. You had nominal treatments, to quiet your suspicions—but immortality isn't for traitors!"

His face hardened.

"Governor Hale and I have been waiting, hoping to locate the top man in your organization. Certain events forced us to move now. We still intend to get the top man and render him harmless to civilization, but the present problem is what to do with traitors.

"I condemn you to death."

The silence began and ticked on and on—longer on landside than in the Keeps. For the colonists knew time now.

Sam made a little gesture.

"You will be taken under escort back to whatever Keeps you may elect. None of you may return. The colony is closed to all of you. So is the immortality treatment. You had your chance to live for a thousand years, and you chose a traitor's way instead.

"You will not be harmed. You will be taken back to the Keeps—and be free. Until you die. And you will die not in a thousand years from now, but in thirty, forty, fifty, perhaps. I withdraw the boon of immortality from you, and therefore I condemn you to death by natural causes."

"Go back to the Keeps. We don't want you here."

He brought his hands together in the conventional gesture.

"The trial is over."

Trial: A testing of capacity—

"Message to all Keeps: You will no longer pay korium ransom to Plymouth Colony. You will pay it to the Venusian Provisional Government. We are taking control of the planet. We have means to enforce our demands. Message to the Plymouth Colony: ground all your planes or be destroyed—"

Triangulation couldn't locate the source of the message. It kept moving. And it was always at sea. Apparently the call was being shifted rapidly from transmitter to transmitter—planes, perhaps, though no radar apparatus recorded unauthorized planes in the Venusian atmosphere.

Sam's answer to the challenge was brief—"Surrender!"

"We have means to enforce our demands—"

Sam's face appeared on all vision screens, in the Keeps and in the colony.

"An all-out offensive has been organized from Plymouth Colony. For the first time the mutineers

have come out in the open. Now we can find and smash them. We *will* find them. Television reports on our progress will be relayed as we proceed. Special ships and plane crews are being sent to guard the sea areas above every Keep. We are taking all possible precautions. Unauthorized plane approaching Plymouth Fort has been fired on; it is retreating southward. I must direct certain operations; one of our Operations Officers will take over and keep you informed."

Sam was in his tower. He was alone. For months he had superintended the installation of one-man apparatus. Some tasks he could relay, but the main job depended on him alone. It would be no easy task.

The skip-source message came from the Venusian seas.

"Ground your planes, Plymouth Colony! You can't survive atomic attack!"

Every listener thought suddenly of the memorial eidolon in every Keep; the black-plastic shrouded sphere of the lost Earth. Atomics on Venus—for warfare? Atomic power that could so easily become uncontrollable.

Visors showed infra-red and radar jungle vistas as Sam's planes quartered landside and the sea, delicate instruments probing into the black secret fury of native Venus, searching efficiently for the marauders who called themselves the Venusian Provisional Government.

"This is an ultimatum. You have forty-eight hours. At the end of that period, one of the Keeps will be dstroyed."

Atomics!

That was the old, terrible fear. That was the terror that had come down in the race through seven hundred years. And in the Keeps the years had meant nothing—had been as meaningless as the hourless days.

Forty-eight hours?

Time had come to the Keeps at last.

Two planes were shot down before they got too close to the fort. Tractor rays eased them to the ground, and there were no explosions. But the threat of the atomic warhead moved closer.

Sam said: "In our all-out effort, we have recalled our men already assigned to the colony expansion effort—our newest venture." His tired, strained face gave way to a view of a wide, cleared area on a seacoast, with its familiar jungle backdrop. Some huts had already been constructed, and others stood half-completed, the plastic layers only partly sprayed on the custom-shaped balloon foundations. Piles of equipment were neatly lined up. But orderly crowds of men were moving toward the motor-powered barges beached to receive them.

"The mutineers have not yet been located. Our planes are proceeding with their search—"

The patterns of radar gave place to depthless, infra-red jungle, seen from far above. It shifted back to the radar matrix as the plane swept on, probing with all the mar-

velously keen sensory equipment technology had given it.

"Forty-seven hours. You have forty-seven hours. Plymouth Colony, ground your planes. We have atomic power and we will not hesitate to use it—"

Time . . .

"You have forty-six hours—"

And fear swept the Keeps. Crowds seethed the Ways, gathering at the cloverleaves where the big visor screens were set up. Zachariah Harker said to Kedre:

"The body politic is more than a figure of speech. The Ways, you know, are like the circulatory system. When too many people gather, forming—well, blood clots—then there's danger of an aneurysm."

"Zachariah—" Kedre said.

He took her hand.

"I don't know. I don't know, my dear. I'm trying to think. We still have forty-five hours."

"You have forty-four hours."

"Another attacking plane has been shot down and eased with tractor beams thirty miles from Plymouth Fort. No atomic explosion resulted. This plane was radio-controlled. The robot-guide signals were relayed from constantly shifting areas at sea."

Hale looked at the Logician.

"Things level off," Ben Crowell said packing his pipe.

"It's all right for you to talk. You know the answers. I don't."

"Time to look for real trouble is when you don't see any," Crowell pointed out. "You might see some harmless-looking plants, little ones, and you wouldn't think there's a Man Underground root twenty feet long hiding 'way down, waiting for the right time. Right now—" He glanced at the Keep announcer on the nearest screen. "Well, you don't see me interfering, do you?"

"No. And you ought to be more excited, with atomic war threatened. Even the Free Companies outlawed atomics for offense."

"You have forty-three hours," the screen said.

"You have twenty-four hours."

"You have twenty hours."

"You have sixteen hours."

"Sam Reed speaking. We've found the skunks!"

The screens showed jungle, seen from high above—green, luxuriant, writhing with life. No more than that. Then the bombardment began, acid, flame, rays, and the fury of man's own weapons crashed against the fury of Venus.

The jungle green blackened. It writhed in torment. It flung up huge ropes of screaming vines. Clouds of flying things poured away from the center of that circle of awful holocaust. The towering, pillarlike neck of the thunder-lizard curved up; the red maw opened. The hissing shriek of the saurian rose high and keening

through the dull, incessant roar of the blasting rain from above.

"Surrender! We'll destroy the Keeps—we won't hesitate—stop your attack—"

There was only raw, blackened, steaming earth now where there had been jungle.

The soil melted and crumbled. It flowed like lava. A white-hot lake began to grow. Pressure-jets blasted down, forcing the molten rock out from its lake in a flashing, incandescent spray. And something seemed to rise from the turgid steaming depths. As the molten level sank, a gray, rounded surface emerged.

Sam's face flashed on to the screens.

"You are seeing the secret headquarters of the mutineers," he said. "You will see it destroyed now."

A voice shouted: "We'll destroy the Keeps! Stop your attack—"

The gray dome stood sullenly in the white-hot lake.

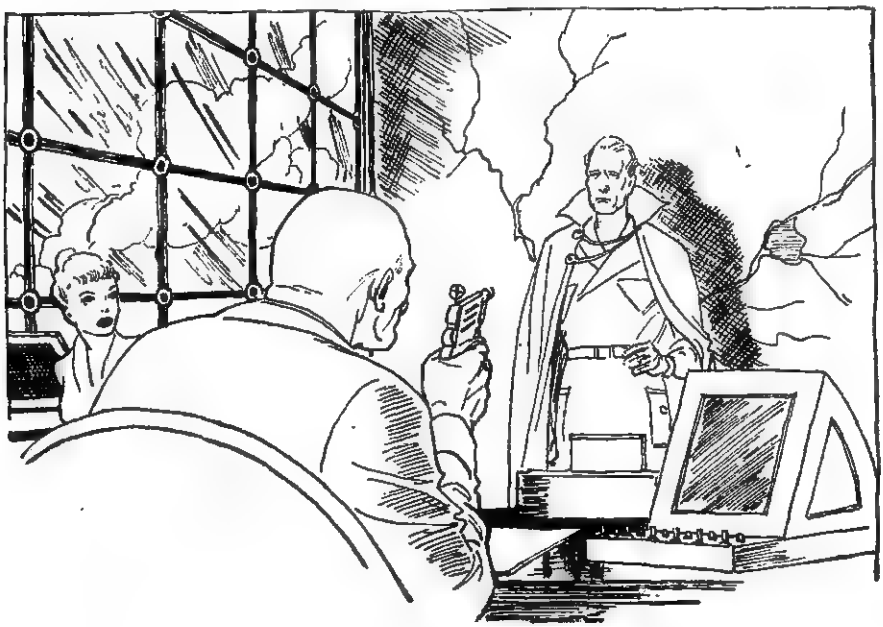
The black torpedo shape of a bomb dropped. The gray dome was tough. But then another bomb dropped.

And another.

The first explosion had not mushroomed before the next missile hit. Then the next. And there was no cessation, no pause in the terrible regularity of the pin-point bombing. Hammer-blow after hammer-blow struck. Four—five—six—

Sam dropped forty-eight bombs, one for each hour of the deadline the Venusian Provisional Government had given him.

The screens showed smoke.



When at last the smoke cleared—they showed such ruin as not even the fury of Venus's jungles, could achieve. The Man Underground was rooted out at last.

And twenty submarines discharged extremely specialized torpedoes at the impervium domes shielding the Keeps.

Six hours later Zachariah Harker was speaking to the Keeps.

"The mutineers were destroyed by Sam Reed. But they had a suicide fleet. As they died, they had their revenge. The impervium dome above Delaware Keep has been radioactivated. The same holds true for all the Keeps. One moment—" He turned away, and presently returned.

"I am told that new messages have recently been received—the mutineers were not all destroyed. Apparently there were some survivors. They are harmless at the moment, but they comprise a permanent threat until they, as well as their organization, is eradicated. Completely. Meantime, their revenge is effective. Within a week the danger level will be reached, and the Keeps will be uninhabitable.

"Do not be immediately alarmed. There is no chance that the activated impervium will reach critical mass. But there is no way of halting the atomic reaction, and after a week has passed, the Keeps will be slow death traps. Only one solution seems practical. There is no time to build new impervium domes undersea—yet. But it may be done on landside. Here is Sam Reed; let him tell you his plan."

Sam's face appeared.

He said almost casually, "We did our best, but the skunks had the last word. Well, you've got to leave the Keeps—all of you—or die. I told you, I think, that we had been planning colony expansion. We've cleared a great deal of ground in preparation for that, and have already set up some equipment. It's yours. We'll stay in Plymouth or start new colonies. The land we cleared, and the equipment, is at your service. In this hour of disaster, we'll have to work together; we're one race.

"In a week you can transport the *materiél* you'll need. It won't be an easy life, but it'll be life. We of Plymouth Colony stand ready to help you to the fullest extent. Good luck."

Someone else appeared on the screen; Sam and Zachariah began talking on a private beam.

"Can you evacuate the Keeps in a week?"

"Easily. Since we have to."

"All right. We'll have to work together—for a while at least. Kedre proposed that once, and I said no. But now I'm proposing it. We'll send special officers to advise you on what equipment will be required. In the cleared areas, the first problem will be medical. We'll supply medical administrative officers. You've got to stay alive and healthy, and you're not acclimated to landside life. Don't count too much on impervium domes. We haven't wiped out the mutineers,

and what they can do once, they can do again. When you're under impervium, you're vulnerable. If the survivors get organized again—"

"Landside life will be hard on the old and infirm."

"The strong men will have enough to do. There will be plenty of maintenance jobs that won't require physical fitness. Jobs that have to be done. Give those tasks to the old and infirm; that way, you'll release the strong ones for work that takes strength. You'll have a lot of clearing and building to do."

"Our technicians estimate the half-life of activated thorium at twelve years. We can return to the Keeps after twelve years."

"But you'll have to live until then. And don't forget the survivors—the ones we didn't blast. They could reactivate the Keep domes, unless we catch them first. Twelve years is a long time."

"Yes," Zachariah said thoughtfully, looking into his grandson's oblivious face. "Yes, I expect it will be a long, long time."

And the Lord said . . . .Depart and go up hence . . . unto the land which I sware unto Abraham . . . a land flowing with milk and honey . . . And the children of Israel went into the midst of the sea upon the dry ground, and the waters were a wall unto them on their right hand and on their left.

—Exodus

Seven hundred years ago the last exodus of the race of man took place. Today it began again. The vast mass migration was too complex for any single mind to encompass, and the people who looked back on it later remembered only intolerable confusion of the mind—hysteria, near panic, blind rebellion against destiny, but concerted, obedient motion as an over-all pattern. The people of the Keeps had learned docility the easiest way of all. Now they did as they were told, grumbling, frightened, unwilling, but obeying the orders of anyone who spoke with enough authority.

No one would have believed, beforehand, that so tremendous an exodus could take place in the time allotted. No one, looking back, quite understood how it had been accomplished. But accomplished it was. That incalculable weight of inertia in a people contentedly settled for seven hundred years in one place required an even more incalculable weight in the scales to tip them over into action—

And they had that weight. The nucleon. Weightless by any comparable scale of physical values, still it tipped the balance as no other thing could. There was one old, old terror in the mind of every man who had ever looked up from the moving Ways and seen the globe of lost Earth hanging in the center of every Keep, shrouded in its symbolic pall.

They moved.

Kedre looked around her beautiful quiet room for the last time. It was a long look, quiet, like the room.

"We won't come back," she said. Zachariah, waiting at the door for her, said patiently, "Why?"

"You know we won't. And it's a good thing. I hate Sam Reed. He's always forcing me to face unpleasant truths for perfectly irrelevant reasons of his own. He isn't doing this because it's time and past time for the sake of the race. He's doing it because he told a monumental lie and couldn't think of any other out."

"I wonder if we'll ever be able to prove it?"

Kedre shrugged. "If we could, it wouldn't matter, now. We know Sam's methods. Once before when he was in a desperate spot he took desperate measures, We've expected it again ever since. I didn't give him credit for such misdirection, but Sam's learning fast. No, I don't suppose it ever can be proved."

"Are you ready, my dear? The lift's waiting."

"All right." She sighed, turning to the door. "I shouldn't feel as if I'm going out to die. I'm just now going to vindicate my own existence by starting to live! It'll be uncomfortable and I suppose dangerous, though I mind danger less. But it's something that's needed doing for longer than I like to think. Only—Zachariah, it's so horribly ignoble to be *forced* to do it!"

He laughed. "I feel the same way. I suppose the first invertebrates who crawled up out of the prehistoric seas felt just as we do—hating every minute of it. It's time mankind crawled out of the water and stood on dry land again, but even Sam Reed can't make us like it!"

"He'll be sorry." She buckled the cloak at her throat and crossed the room on lingering feet, pressing each step into the resilient flooring she would probably never walk again except out of curiosity, perhaps a century from now. "How strange it will all look then," she thought. "Dark and stifling, I expect, after so long in the free air. We'll wonder how we ever stood it. Oh dear, I wish Sam Reed had never been born."

Zachariah held the door for her. "Our plans will still go forward, landside," he said. "I checked about your . . . your time-bomb. Parents and child are safe up there, in a sheltered job."

"I wish," Kedre declared, "that it had been a boy. Still—this may make a better weapon, after all. And it isn't our only weapon, of course. *Sam has got to be stopped.* We may have to use weapons as disreputable as the ones he's used against us, but we'll stop him. We have time on our side."

Zachariah, watching her face, said nothing at all.

"I knew you were up to something," Hale said, "when you let all those mutineers go. It isn't like you to let anything go you can use."

Sam looked at him under meeting brows. "You wanted to colonize landside," he said uncompromisingly "Well, this is it."

"Robot submarines, robot planes,

remote control—and a long-term plan," Hale said amusingly, and shook his head. "Well, you've done it. No one else in the world could have, but you did."

"After twelve years," Sam told him calmly, "they'll be pretty well acclimated. After another twelve—and maybe another—they're going to like it up here so well you couldn't drive them back. Remember you told me once what makes pioneers? Push plus pull. Bad home conditions or a Grail somewhere else. The Grail wasn't enough. Well—" He shrugged.

Hale was silent for almost a minute, regarding Sam with his steady stare that had seen so much on Venusian landside before now. Finally he spoke.

"Remember what happened to Moses, Sam?" he asked gently, and then, like a classic prototype, turned and went out of the room, not staying for an answer.

The race struck roots and grew. Slowly at first, reluctantly, but with gathering vigor. And down in the deserted Keeps, in the first few days after the departing thousands had gone, for a little while life still moved through the strange new silence of the dying cities.

There were those who did not choose to leave. Some of the old people who had always lived here and could not face life above water, some of the ill who preferred the slow, comfortable death that had been provided for them. Some of the drug addicts. Silently in the deathly silence they moved through the empty shells. Never before since mankind first colonized Venus had such silence dwelt beneath the domes. You could hear the slowing Ways sighing on their rounds. You could hear strange, vague underwater noises transmitted from the great sounding-boards of the city shells. You could hear sometimes the shuffling footsteps of some fellow wanderer.

But after a little while all footsteps ceased, and all sounds except the echoes from the seas outside.

The thick walls shivered in the thunder of bombardment. In Sam's hand the stylus danced upon the suddenly shaking paper. His desk top shook, and the chair he sat in, and the floor quivered rhythmically and was still. Sam grimaced without knowing it. This was the third day of the bombardment, and he had shut his mind to the minor irritations of the unstable walls.

A young woman in a sleekly severe brown tunic bent forward, watching him write, her black hair falling in short, straight wings across her face. She pulled the page off the pad almost before his stylus had finished writing, and went quickly across the trembling floor to her own desk. There was a televisor on it, and she spoke rapidly, in a soft, clear voice, into the transmitter. In a dozen other visors scattered about the vast, beleaguered fort her tanned face was the target for intense attention as Sam's lieutenants received their latest orders. In a dozen visors her violet-blue eyes looked out narrowed with in-

tentness, her velvety voice gave incongruously stern messages.

"All right," Sam said wearily when she had finished. "All right, Signa, send in Zachariah now."

She rose with a smooth precision of motion that was beautiful to watch, and went quickly across the floor. The door she opened led not directly into the waiting room beyond, but into a little space lock that could be bathed at a touch by searcher beams to catch the presence of any weapon a man might try to smuggle past it. Sam took no chances. It didn't seem to matter much now—perhaps he had too long mistaken personal safety for group safety. The bombardment roared again and for the first time a long delicate crack went flashing like slow lightning down one wall. The space lock would seem futile enough when the walls themselves began to go. But for a little while longer it must be used.

Two guards came in at Signa's beckoning, and paused perfunctorily in the lock and stood back for their prisoner to take his turn in the invisible bath of the beams. Two more guards came after.

Zachariah had a cut lip and a darkening bruise on one side of his ageless face, but he looked remarkably confident in spite of his manacles. Except for his tan he had changed little. He was still head of the Harker clan, and the Harkers were still the most influential family on Venus. But if Sam's coup in capturing the leader of the attacking forces meant anything, Zachariah did not show it.

Twenty years had not been a very long time.

The Keeps were still uninhabitable. The change-over to landside living had come very gradually, but it was complete by now. The signal for completion had been sounded on that day when instruments first showed that the atmosphere of Venus had at last shifted over to an ecology balance that matched Earth's. Crab grass and earth-native herbs with a high oxygen output had finally tipped the scale. From now on, this continent could be left to itself, botanically speaking. For the plants had changed the air. The heavy carbon dioxide atmosphere in which Venusian flora flourished would foster them no longer. What is normal for Earth-born plants is poison for the Venus-grown things that were so often neither plant nor animal, but a deadly symbiosis of the two.

It was this shift that the spreading colonies had been awaiting.

It was this war that came of the shift.

"Zachariah," Sam said in a weary voice, "I want you to call off your men."

Zachariah looked at him narrowly, not without sympathy, trying as he had so often tried, in vain, to trace some likeness to the Harker blood that ran in them both. "Why should I do that, Sam?" he asked.

"You're in no position to bargain. I'll have you shot unless this attack's stopped by noon. Step over here—you can use my telecaster."

"No Sam. You're finished. This time you can't win."

"I've always won before. I can do it again."

"No," Zachariah said, and paused for a moment, thinking of those many times in the past when Sam had won—easily, scornfully, because of his impregnable defenses built up so cannily in years of peace. When the Immortality bubble broke completely, there had been rash, furious, tragically futile assaults upon this great white fortress that sheltered the most powerful man on Venus.

"We aren't guerillas," Zachariah said calmly. "We've been building up to this attack since the day you pirated our korium with the depth-bomb threat. Remember, Sam? You haven't made many mistakes in strategy, but you should have checked the equipment we took landside with us when we left the Keeps. A lot of it was stuff we're using now." He looked at the jagged lightning-streak that was creeping down the wall as the bombardment went on. "This time we've got you, Sam. You've been building for defense a long time—but not as long as we've built toward this offense."

"You're forgetting something." Sam's head ached from the incessant vibration. It made talking difficult. "You're forgetting yourself. You aren't really willing to be shot rather than call off the attack, are you?"

"That's something you couldn't understand, isn't it?"

Sam shook his head impatiently. "You'd have attacked twenty years ago if you were as strong as you pretend. You aren't fooling me, Harker. I've never been licked yet."

"We've needed you—until now. You've lived on sufferance, Sam. Now it's over. This bombardment isn't only guns. It's the . . . the pressure of human emotions you've held down too long. You've tried to bring progress to a full stop at the level of your choosing, and you can't do it, Sam. Not you or anybody. For twenty years that pressure's been building up. You're finished, Sam."

Sam slammed the vibrating desk top with an angry fist. "Shut up!" he said. "I'm sick of talk. I'll give you sixty seconds to make up your mind, Harker. After that—*you're* finished."

But there was in his mind as he said it a nagging uneasiness he could not quite name. His unconscious mind knew the answer. It nagged at him because Zachariah's capture had been too easy. Sam's conscious awareness had not recognized the incongruity yet; perhaps his vanity would not permit it. But he knew something was wrong about the setup.

He glanced nervously around the room, his eyes pausing for a moment, as they so often did, on the blue-eyed girl at the desk across the room. She was watching everything in alert, tight-lipped silence, missing nothing. He knew he could trust her. It was a heart-warming assurance to have. He knew because of the exhaustive psychological and neurological tests that had

winnowed out all applicants except the half-dozen from which Signa had been chosen.

She was eighteen, Keep-born, landside-bred, when she first entered the Fort as a clerical worker. All of them were screened thoroughly, of course. All of them were indoctrinated from the first with the precepts Sam's psychologists had worked out. But Signa rose faster than most toward the top. Within a year she was an assistant secretary in the restricted building that housed administration. Within six months from then she was a secretary with an office of her own. And then one day Sam, looking over applicants for his personal staff, was rather surprised to find a woman's name among those with top-flight test ratings. One interview clinched the appointment for her.

She was twenty-five now. She was not Sam's mistress, though few in this Fort would have believed it. Periodically she underwent further tests, under narcosynthesis, to make sure her emotional reactions had not changed. So far they had not. She was utterly to be trusted and Sam's efficiency would be halved, he knew, if he had to work without her now.

He could see that something was troubling her. He knew her face so well the slightest shadow on it was recognizable. There was a crease between her brows as she looked at Zachariah, and an expression of faint uncertainty, of puzzled anticipation flickered in her eyes.

Sam looked at his wrist. "Forty seconds," he said, and pushed back his chair. Every eye in the room followed him as he went over to the far wall, the wall where the long crack was widening, and flicked a switch in a six-foot frame. A shuttered screen, filling in the frame, began to open slowly. From behind it a faint, sweet, infinitely seductive humming swelled. Sam was reaching for the lid of a box set into the wall beside the frame when a buzz at Signa's visor interrupted him.

"For you, Sam," she said in a moment. "Hale."

He flicked the switch again, closing the screen, and went rapidly across the room. The Free Companion's brown unaging face looked up at him from the tilted visor.

"You alone, Sam?"

"No. Wait, I'll switch to earphones."

The face in the screen grimaced impatiently. Then, at Sam's signal the face vanished again and Hale's voice buzzed in his ears, unheard except by Sam.

"There's been a breakthrough," Hale said crisply.

"How bad?"

"Bad enough. Vibration did it. I told you I thought that plastic was too rigid. It's down in the lower court. They've already manned some of our own guns and swiveled them around. The upper bailey's going to start getting it in about five minutes. Sam—I think there's been a leak somewhere. They shouldn't even know how those needle guns work. But they do."

Sam was silent, his mind flickering rapidly from possibility to possibility. Hale himself was as

suspect as any. It had been a long, long while since Sam had trusted the Free Companion. But he had made grimly certain of Hale's loyalty by insuring that public opinion bracketed the two men together. Hale profited by Sam's methods. Sam made sure all Venus knew it. He made sure that Hale's part in originating unpopular ideas—from the Immortality swindle on down—was fully publicized. It was fairly certain that Hale would have to back Sam up in all he did, if only to save his own hide.

"I've got Zachariah here," he said into the transmitter. "Come up, will you?" He slipped off the earphones and turned back to his prisoner. "Your minute's up," he said.

Zachariah appeared to hesitate. Then he said, "I'll talk to you, Sam on one condition. Privacy. We'll have to be alone for what I have to say."

Sam opened his desk drawer, took out a flat pistol and laid it on the vibrating desk-top, his palm over it. "You'll talk now, Zachariah Harker," he said, "or I'll shoot you. Right between the eyes." He lifted the pistol and regarded Zachariah down its barrel, seeing the serene Immortal face half blocked out by blued steel.

Silence. Then from far off, muffled by walls, the unmistakable piercing wail of a needle-gun bolt split the air of the inner fort. Impact, dull thunder, and a long sliding crash. The walls shook briefly to a new tempo and the crack widened at Sam's back.

Zachariah said, "You'd better let me talk to you, Sam. But if you'd rather shoot—shoot. I won't say it until we are alone."

Sam's hesitation was not very long. He knew now he was more shaken than he had realized until this moment, or he would never have surrendered to a bluff. But he let the pistol sink slowly, and he nodded.

Signa rose. "All right, guards," she said. They turned and went out through the still activated searcher lock. She put her finger on its switch and looked inquiringly at Sam. "Shall I go, too?"

"No," Sam said. "Not you." His voice was firm.

"Sam, I . . . I'd rather go." She sounded oddly puzzled and distressed. It was Zachariah who spoke first.

"You stay, please," he said. She gave him another of her strange glances, uncertain, troubled.

Sam watched them leaning his hands palm down on the desk and feeling the almost continuous vibrations of the bombardment. The air was pierced now and then by the screaming needle beams, and he did not like to think what was happening to his inner ring of defenses around the upper bailey.

"All right," he said. "What is it? talk fast, Harker. I'm in a hurry."

Zachariah, hands still manacled behind him, crossed the room and stood looking out the bank of windows that framed a vista of distant sea.

"I'll show you," he said. "Come over here."

Sam came impatiently across the shaken floor. "What? What is it?" He stood beside the Immortal, but a safe distance away, for caution was second nature to him, and looked down. "I don't see a thing. What is it?"

Zachariah whistled the opening bars of *Lilibulero* . . .

The room exploded with thunder.

Sam found himself reeling, choking, gasping for breath, with no clear idea of what had happened. *A needle beam,* he thought wildly. But then the whole room would be a shambles, and it was only himself, leaning one shoulder against the wall, shaking his head dizzily, breathing hard, who seemed affected.

He looked up. Zachariah still stood by the window, watching him with a kind of hard restrained pity. The room was untouched. And there was something the matter with Sam's shoulder.

That was where the blow had caught him. He remembered now. He put up an unsteady hand to the numb area and then looked unbelievingly at his palm, filmed with clear red. Something moved across his chest. Incredulously he bent his head and saw that it was blood. The bullet must have come out just under the clavicle.

Signa's soft, clear voice gasped, "Sam . . . Sam!"

"It's all right . . . it isn't bad." He was reassuring her even before he lifted his head. Then he saw her standing behind his desk, the flat pistol held in both shaking hands. She was staring at him with great, terrified eyes and her mouth was a Greek square of strained effort. Her stare shifted from Sam to Zachariah and then back, and the incredulity in it was very near sheer madness.

"I . . . I had to do it, Sam," she said in a harsh, thin whisper. "I don't know why—there must have been a reason! I don't understand—"

Zachariah broke in, his voice gentle. "It wasn't enough, Signa," he said. "You'll have to try again, you know. Quickly, before he can stop you."

"I know . . . I know." Her voice was a gasp. Normally she was a good shot, fast and easy, but she brought the pistol up in both hands, steadying it like a schoolgirl, squinting past the barrel. Sam saw her finger begin to draw up on the trigger.

He didn't want to do it. He would almost rather have risked the shot. But he dropped his right hand to his side, found through cloth the outlines of the tiny needle gun in his pocket, and shot from the hip without taking aim.

He did not miss.

For one long last moment, afterward, her eyes were wide and brilliantly violet, staring into his. Sam scarcely heard the thud of the dropping gun. He was meeting her blue stare and remembering another blue-eyed girl, very long ago, who had faced him like this and puffed oblivion in his face between her fingers.

He said, "Rosathe!" as if he had

just remembered the name, and swung around toward Zachariah It was the same triangle, he thought savagely—Zachariah, Rosathe, Sam Reed—sixty years ago and now. There was no difference. But this time—

His fingers closed on the needle gun again and its bolt hissed again across the room. Zachariah, seeing it coming, made no move. But when it came within six inches of his chest it seemed to explode in midair. There was a scream of expended energy, a flare like a miniature nova, and Zachariah smiled unhurt into Sam's eyes.

What he said made no sense. He still looked at Sam, but he lifted his voice slightly and called, "All right, Hale, it's up to you."

There was a challenge in the words. Sam had no time to puzzle it out. He set his teeth grimly and tugged the needle gun from his scorched pocket, lifted it toward Zachariah's face. There at least the Immortal could not be wearing armor.

He never pulled the trigger. From somewhere beyond him a familiar voice said wearily, "Harker—you win." And a searing light flashed blindingly into Sam's eyes.

He knew what it was. He and the Free Companion carried the little riot-breaker flashes instead of deadlier weapons for discipline. Blindness was not usually permanent after that glare had burned a man's eyes, but it did not pass quickly.

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In the sudden darkness that had engulfed the room Sam heard Zachariah's voice saying, "Thank you, Hale. I was pretty sure you would —but not quite. That was close."

The Free Companion said, "I'm sorry, Sam."

And that was the last thing Sam heard in Plymouth Colony.

And Moses went up from the plains of Moab . . . and the Lord said unto him, This is the land. . . . I have caused thee to see it with thine eyes, but thou shalt not go over thither. . . . And Moses died there in the land of Moab, but no man knoweth of his sepulchre unto this day.

—Deuteronomy

There was a swimming dark, and the roaring of winds. And then vague patterns of light that were presently a face—the head and torso of an old man, a shrewd-faced, wrinkled old man Sam recognized. Beyond him was a bare alloy wall, and a dim light came from somewhere.

Sam tried to sit up, failed, tried again. He could not move. Panic leaped in his mind. The old man smiled.

"Take it easy, son. This is the way it has to be." He was packing tobacco into his pipe as he spoke. Now he held a flame to it, sucked the fire down into the bowl, blew out smoke. His mild gaze focused on Sam.

"Had to tell you a few things, son," he said. "Just in case. You're good and healthy again, in case you're wondering. You been here a few weeks, resting up, getting cured. Nobody knows but me."

Where? Sam tried to move his head enough to see the source of the light, the shape of the room. He could not.

"I got this hideout ready quite some while ago," Crowell went on, puffing. "Figured I might need it for something like this. It's under my potato patch. I'll be hoeing spuds on this parcel of land for a good long spell yet, I figure. Maybe a hundred years, maybe five hundred. That's right, I'm an Immortal. Don't look it, do I? But I was born on Earth."

He blew out blue smoke. "Earth had a good many fine things—the old place. But I could see what was coming, even then. I could see you, Sam Reed. Oh, not your name or your face, but I knew you'd be along. A man like you always is, at the right time. I can figure out the future, Sam. It's a talent I got. Only I can't interfere or I'll change the pattern to something different—what it'll be I can't tell for a while, after I've stepped in."

Sam made a frantic effort to stir one finger. Colored flecks of light danced before his eyes. He scarcely heard as the old man rambled on.

"Easy now," Crowell said quietly. "Just try to listen for a bit. I'm the Logician, Sam. Remember the Temple of Truth? You didn't believe the oracle at first, did you? Well, I was right. I was the machine, and I don't make mistakes, at least, not that kind.

"You were in the Temple for forty years, Sam. You wouldn't remember that, either. You were dream-dusting."

Dream-dusting? Sam's attention came back sharply. Was this the answer he had sought so long, given casually now, when it no longer meant anything? Crowell, the unknown guardian? But how—why—

"Zachariah was out to kill you. I could see that. I could see he'd succeed, unless I interfered. So I interfered—which upset the apple cart considerable. After that I couldn't figure out the future quite so close, till things evened up again. That's one reason I waited forty years. It's why I let you wake up in an alley, broke and disgraced. To even the scale, son. The way things are, when I give a good present I've got to give a bad one too, or it won't come out right.

"You had your troubles to straighten out then, and when you finished, the pattern was all set again. I could see what was coming."

Sam did not care. If he could only break this paralysis. He must—he must! Always before now he had drawn upon some deep reserve of strength no other man possessed. And it must not fail him now.

But it was failing him.

"You're not Sam Reed, you know," the Logician was saying. "Remember Blaze Harker? He had a son. Blaze was starting to go crazy then, or he'd never have hated the baby enough to do what he did.

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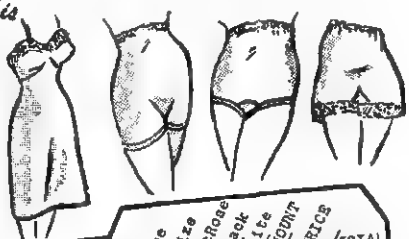

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You know what it was, don't you? You grew up looking like a short-termer, but your name wasn't really Reed."

Blaze Harker. Blaze Harker, his face distorted, struggling in the strait-jacket—

I let him go! I could have killed him! He was the one—I let him go—

Blaze Harker!

Harker!

Sam—*Harker!*

"I couldn't tell you before," Crowell said. "It would have changed the future, and I didn't want it changed that way. Up till now we've needed you, Sam. Once in a long while a fella like you comes along, somebody strong enough to move a world. Oh, I guess other men had qualifications—like Rob Hale. Only Hale couldn't have done it. He could have done part of what was necessary, but there are things he never could make himself do.

"There's nothing you wouldn't do, son—nothing at all—if it would get you what you want.

"If you hadn't been born, if Blaze hadn't done what he did, mankind would be in the Keeps yet. And in a few hundred years, or a thousand, say, the race would have died out. I could see that ahead, clear as could be. But now we've come landside. We'll finish colonizing Venus. And then we'll go out and colonize the whole universe, I expect.

"You're the one who did it, Sam. We owe you a lot. In your day you were a great man. But your day's over. You got your power by force, and you're like most dictators, son, who reach the top that way. All you could think of was repeating the things that made you a success—more fighting, more force. There wasn't any way but down for you, once you'd reached the top, because of the man you are. You had the same drive that made the first life-form leave water for land, but we can't use your kind any more for awhile, Sam."

Drive? It was fury. It burned with blinding white violence in him, so hot it seemed strange the fetters of his paralysis were not consumed—it seemed strange the sheer violence of his rage could not send him headlong across the room at Crowell to strangle him. To get above ground—smash Hale. Smash the Harkers—

The Harkers. But he was a Harker, too.

Crowell said, "Men like you are mighty rare, Sam. When they get to the right position, at the right time, they're the salvation of the race of man. But it's got to be the right time—a time of disaster. The drive never stops, in a man like you. You've got to get on top. You've got to, or die.

"If you can't conquer an enemy, you'll conquer your friends. Up to now the enemy was Venus, and you licked it. But what have you got to fight now?"

"Man."

"There's going to be a good long time of peace, now. The Immortals have taken over. They'll rule well.

You've left them a good foundation to build on. But it's time you bowed out."

Suddenly Crowell chuckled. "You thought you were telling a lie, Sam, when you promised immortality was up here landside, didn't you? It was the truth. They'll get their immortality. Ever think of that? Man was dying in the Keeps. Up here he'll live on—well, not forever, but long enough, long enough. The race has got immortality, Sam, and you gave it to 'em."

He puffed again at the pipe and looked down reflectively through smoke at Sam. "I hardly ever interfere with the running of things," he said. "Only once I had to kill a man. I had to. It changed the patterns so much I couldn't see the future for a long time after, but I'd already seen enough to know what would have happened if the man kept on living. It was bad. I couldn't think of anything worse. So I killed him.

"I've interfered again, because I know what the future would be like with you in it. This means I won't be able to guess what's coming for quite a spell. After that things will level off and I can take a look.

"This time I'm not killing. I learn more as I get older. Also, you're an Immortal. You can sleep a long, long while without losing anything. That's what you're going to do, son—sleep.

"And I hope you die in your sleep. I hope I'll never have to wake you up. Because if I do, it'll mean

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things have gone mighty bad again. You and I are long-termers. We'll still be around, barring accidents, for quite a stretch yet. And plenty of bad things can happen.

"I get glimpses. Nothing's set yet—too far ahead. But I see possibilities. The jungle could come back. New life-forms may mutate—Venus critters are tricky. And we won't stay on Venus forever. This is just the first colony. We'll go on out to the planets and the stars. There may be trouble there, too, sooner than you'd think. Maybe something will try to colonize our worlds, as we colonize theirs. Plenty we don't know yet, but we're not the only intelligent species in the universe. There's peace and there's war, and it's always kept on that way, and I guess it always will.

"So maybe we'll need a man like you again, Sam.

"I'll wake you if we do."

The shrewd brown face regarded him from coils of smoke. The friendly, remorseless, judging eyes considered him.

"For now, though," Crowell said, "Go to sleep. You've done your job. Sleep well, son—and good night."

Sam lay motionless. The light was dimming. He could not be sure if it were his own vision that dimmed. The rage ebbed in him, and the darkness rose.

There was so much he wanted to think about, and so little time for thinking. He was Immortal. He wanted to live—he must live—

Sam Harker, Immortal. Harker. Harker.

He heard the music of carnival ringing through Delaware Keep, saw the bright ribbons of the moving Ways, smelled drifting perfume, smiled into Kedre's face.

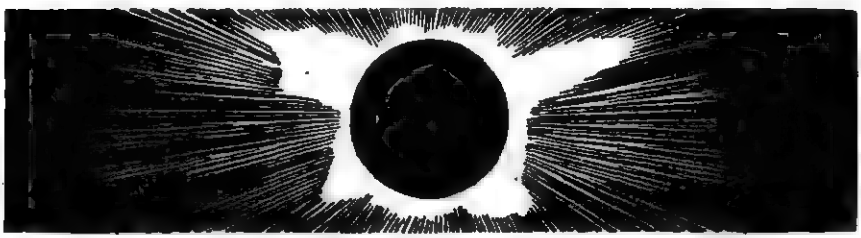
There was a second of desperate urgency, as though he clawed at the edge of a crumbling cliff, while life and awareness fell to pieces beneath his hands.

Darkness and silence brimmed the buried room. Here the Man Underground slept at last, rooted deep, waiting.

EPILOGUE

Sam woke—

THE END.



BRASS TACKS

(Continued from page 83)

THE BOOK REVIEW: was interesting. Incidentally how about a story by P. Schuyler Miller? While I'm at it I could use de Camp, Fletcher Pratt, A. M. Phillips, McDonald, Heinlein, Hubbard and C. L. Moore in my reading. Who couldn't?

Each issue seems better than the one before so keep up the good work.—Rosco Wright, Box 191, Toledo, Oregon.

Here you are at last! The home-made atomic bamb!

Dear John:

Readers of ASF might be interested in the following gadget dreamed up by Professor R. M. Sutton of Haverford. It's an atomic bomb, home-made. The principal materials required are three dozen mousetraps and nine dozen and one corks; no uraninum or other subversive and illegal substances are needed. You dispose the mousetraps on a flat tabletop, fairly close together but not in any orderly arrangement. Set the traps, placing three corks strategically on the wires of each—this is the most dangerous stage in the assembly.

The bomb is now practically complete. We have our fissionable material: the mousetraps, of course, with the corks as ejectable neutrons. We have critical mass. However, the bomb's material is, so to speak, dispersed: if a nucleus fissions now the chances are its neutrons will

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escape and land somewhere on the other side of the room. To correct this, fix a board horizontally about eight inches above the tabletop. This will prevent escape. *Now* stand back and toss that extra cork into the middle of the mess. This is analogous to a stray cosmic-ray neutron wandering into the fissionable material; it starts the works off. *k* is about 3, so the process is rapid; the explosion will be over in about three seconds.

It will make a hell of a clatter.

Congratulations on the last couple of issues of ASF. Most of the local bunch agrees with me that they're pretty terrific. "Maturity," "Pete Can Fix It," "The Equalizer," and "Child's Play," all four, were in my opinion on a par with the best things you've printed. And I liked very much your article on magnesium in *Air Trails*.—Chan Davis.

You want Unknown. *I want* Unknown. *Everybody seems to want* Unknown *back. But* Unknown *wants paper—and we can't get it!*

Dear Sir:

During its publication I was an avid fan of *Unknown*. What has happened? I realize that the war put a definite crimp in the printing of your magazines, but now that newsprint has become more plentiful I had thought that *Unknown* would again come into being. Are the writers no longer capable of writing the excellent stories that you printed in *Unknown?* It would give me great pleasure to read a story about "Mr. Shea" in Roman times or any of the other characters that have ceased to exist except in my memory. Unfortunately, I do not save magazines.

Perhaps a solicitation of subscribers or some other subtle method—five pages of advertising in Astounding—might call to arms some of the former supporters of *Unknown*.—Eugene P. Mahoney, 30 Hubbard Street, Malden 48, Massachusetts.

I agree with you—and hope the authors will!

Dear Sir:

Just a word from a veteran of World War II about your April issue. Of the six stories in this issue, five concern War. Don't you think a guy ever gets fed up with that sort of stuff? It seems that the authors can't work out a single plot any more without at least one war in it. Anyway, the thing I am getting at is some of us guys have had enough fighting and blood and death, without having to endure it all again in our favorite fiction, to last us the rest of our lives.

As far as the stories are concerned, my order of preference is (1) "An Enemy Of Knowledge." (2) "Psych's War." (3) "Time and Time Again." (4) "Home of the Gods." (5) "Answer." (6) "Project." "Noise from Outside" was an unusually fine article.

BUT PLEASE, can't we have at least a few more stories with a little less death and blood?—W. H. Martin, Steamboat Springs, Colo.

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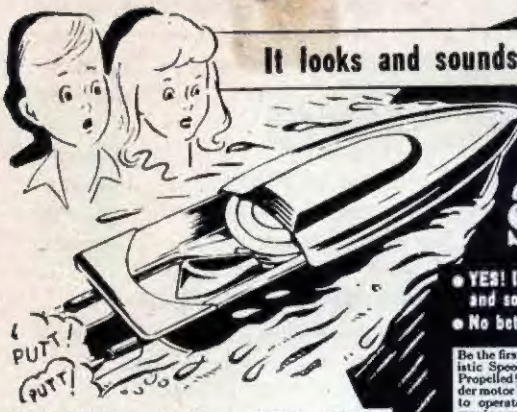

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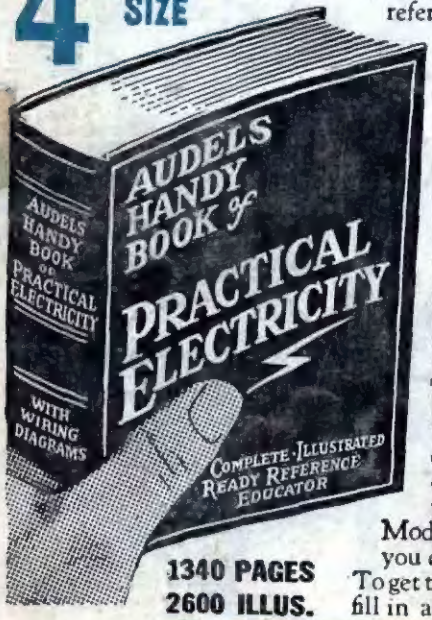
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